The Province of Alberta

PETROLEUM AND NATURAL GAS CONSERVATION BOARD

Application for Permission to Remove or cause to be removed Natural Gas from the Province of Alberta, under the Provisions of the Gas Resources Preservation Act by Northwest Natural Gas Company and Alberta Natural Gas Grid, Ltd.

I. N. McKinnon Esq., Chairman

D. P. Goodall Esq.

Dr. G. W. Govier

Session: MAY 29th, 1950.

Volume 3

I N D E X

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VOLUME 3.

May 29th, 1950.

THE CHAIRMAN: Before we proceed, is there anybody else who wishes to register as an interested party in connection with this application?

MR. A. F. MacDONALD: I do not know whether I should make myself known at the time of this application coming up. This is the first day that the City of Edmonton has been officially represented. I would like to register on behalf of the City of Edmonton, sir. My name is MacDonald, and I am the Assistant City Solicitor for the City.

MR. R. MARTLAND, K.C.: I am appearing on behalf of the Western Pipelines.

MR. NOLAN: Mr. Chairman and Gentlemen, I would like at the outset, if I may, please, just to say in a few words what we intend to prove in evidence on this application. I think that is the procedure that has been followed on the application which is now pending before the Board on behalf of the Westcoast Company.

I do that to give the Board an idea of what lies ahead of us and so the Board may know what witnesses we intend to call. We may not be able to adhere rigidly to the programme which I am now about to outline because the witnesses come from long distances and it may not be possible always to call them in the order in which I am about to set forth. But we expect to call them in the order I am about to mention.

I am going to ask Mr. Faison Dixon, who is the President of the Northwest Company to make an introductory statement. That is not precisely evidence.

It is simply to give information as to the general nature of the project that we are planning and something as to the background of this enterprise. I have not distributed his statement because of the nature of the statement itself, we did not think it was necessary to distribute it seven days ahead. The other material which will be produced by the witnesses has been distributed to all interested parties other than those who are being represented here today for the first time. Following the remarks of Mr. Dixon I will call Mr. Slipper who has made an extensive research into the gas reserves. He will be followed by Dr. Brokaw, a member of the group which conceived this project and is the senior partner of the firm of Brokaw & Company.

Then there will be evidence adduced as to the situation with respect to markets. Mr. Copp, who is an engineer, has made a market study and he will speak generally with respect to markets. Following him, the Vancouver market will be discussed through Mr. Mainwaring and Mr. Davidson. Mr. Mainwaring, as the Board knows, is Vice-President of the British Columbia Electric Company, and Mr. Davidson is an engineer employed by that company. Following Vancouver, we propose to introduce evidence with respect to the market at Trail and I will call for that purpose Dr. Sutherland. Following the Trail submission we will deal with the Spokane market through Mr. Woodworth, who is the President of the Spokane Gas Fuel Company. Then will follow a discussion of the Wenatchee and Bellingham Markets, which will be done by Mr. Stuart Matthews, who is President of the two companies, namely, the Wenatchee Gas Company and the Bellingham Gas Company. Following that, we will discuss the Portland market through Mr. Bell, who is

the Vice-President of the Portland Gas & Coke Company and through Mr. Cook, who is the Assistant to the President of that company. Finally, with respect to markets, the Seattle market will be discussed by Mr. Gellert, who is the President of the Seattle Gas Company, and also President of the Pacific Coast Gas Association.

At the conclusion of the evidence in that regard we will turn our attention to routes and costs. Mr. Goodbody, an engineer with the Haddock-Engineering Limited, will present this evidence and will be supported by Mr. Swinerton of the firm of Swinerton & Wallberg, who is associated also with Haddock-Engineers Limited. Evidence with respect to the Allison Pass Survey will be introduced by Ebasco Surveys, through Dr. A. B. Alleyne. Pipelines design will be discussed, too, by Mr. Dixon, whom I have mentioned before. A statement of earnings and management will be also introduced by that gentleman. Finance will be introduced through Mr. Simonson, who is a partner of the firm of Morgan, Stanley & Company. Finally, there will be a summary of our evidence introduced by Mr. Dixon.

As I said before, sir, that is our expectation, that we may follow that order as closely as may be and if we have to deviate from it it is only because we have to meet the convenience of those witnesses who are coming from long distances. With that, sir, I will have distributed the copies of Mr. Dixon's introductory remarks.

DOCUMENT IN QUESTION
NOW MARKED EXHIBIT 2.

A. FAISON DIXON, having been duly sworn, examined by Mr. Nolan, testified as follows:-

Q Mr. Dixon, you have been sworn?

A Yes.

Q And I have called you for the purpose of making an introductory statement to the Board and I have described that as a statement which will set forth the general plan and background of this enterprise. Is that a correct description of it?

A Yes, sir.

Q You will be recalled at other times during this hearing to give evidence on specific matters, but for the present I would ask you only to direct your attention to your introductory statement and please be good enough to read it to the Board.

A This is a statement of A. Faison Dixon, President, submitted on behalf of Northwest Natural Gas Company, Alberta Natural Gas Grid, Ltd., Applicants for permission to remove or cause to be removed natural gas from the Province of Alberta, under the provisions of the Gas Resources Preservation Act

and

ALBERTA NATURAL GAS COMPANY

(For which company incorporation has been applied for under the Pipe Lines Act, Chapter 20, Statutes of Canada, 1949).

Alberta Natural Gas Grid, Ltd., is a corporation organized and existing under the laws of the Province of Alberta, with corporate powers to construct and operate a natural gas gathering system in Alberta. It has its head office at 8 Canada Permanent Trust Building, Edmonton, Alberta. Its Directors are:

Albert D. Brokaw	New York,
William J. Dick	Edmonton,
A. Faison Dixon	New York,
John Wray Moyer	Calgary,
C. R. Spencer	Calgary.

Its Officers are:

A. Faison Dixon	President
John Wray Moyer	Vice-President
James Walker	Secretary and Treasurer
W. E. Simpson, K.C.	Counsel

We have petitioned for a special Act of the Parliament of Canada to incorporate a company to be called the Alberta Natural Gas Company with powers to transport natural gas inter-Provincially and internationally under the provisions of The Pipe Lines Act. It will have offices at 8 Canada Permanent Trust Building, Edmonton, Alberta. Its Directors will be:

John J. Connolly, K.C.	Ottawa,
William Joseph Dick	Edmonton,
A. Faison Dixon	New York,
H. R. MacMillan	Vancouver,
John Wray Moyer	Calgary,
Cortelyou L. Simonson	New York,
Austin C. Taylor	Vancouver.

Its Officers will be:

A. Faison Dixon	President
John Wray Moyer	Vice-President
James Walker	Secretary and Treasurer
W. E. Simpson, K. C.	Counsel.

It will be a subsidiary of Northwest Natural Gas Company and will own all of the natural gas lines which we propose to build in Canada except those of Alberta Natural Gas Grid, Ltd.

Northwest Natural Gas Company is a Delaware corporation which has registered in, and has qualified to do business in, the Province of Alberta. It also has offices at 8 Canada Permanent Trust Building, Edmonton, Alberta. It has corporate power to construct and operate a natural gas transmission line. It will not do any business in Canada, but instead will be the United States affiliate of Alberta Natural Gas Grid, Ltd., and Alberta Natural Gas Company,

and as such will accept delivery of gas gathered by Alberta Natural Gas Grid, Ltd. in Alberta and transported by Alberta Natural Gas Company into British Columbia and across the border into the United States. It will transport and sell gas only in the United States. I am also President of this Company. A portion of the stock of this Company is now owned by residents of Alberta and British Columbia. A large portion of the stock of this company will be offered to the Canadian and American Public when we raise the necessary funds to construct the natural gas system.

I am making this statement on behalf of the three companies mentioned above.

I am a member of the engineering and geological firm of Brokaw, Dixon and McKee of 120 Broadway, New York, and Gulf Building, Houston, Texas. This firm has been in continuous existence since 1919.

Since 1927 most of the engineering work I have done has been in connection with natural gas. My partners, Dr. Albert D. Brokaw and Mr. H. Harper McKee, and I have been connected, especially during the early stages, with many of the larger gas transmission companies in the United States, including United Gas Pipe Line Company, Panhandle Eastern Pipe Line Company, Tennessee Gas Transmission Company and El Paso Natural Gas Company. Our associates, Mr. Richard B. Hand and Mr. Arthur G. Logan, have had long experience with the legal and financial phases of the long distance transmission of natural gas. I have had experience with construction of large diameter long distance pipelines; I have made many market surveys for natural gas companies, and have made studies of gas reserves. I have qualified

before various regulatory and judicial bodies as an expert witness on these subjects.

My first connection with natural gas in Alberta was in 1933 when my firm made an office report on the possibility of a pipeline from Turner Valley to Winnipeg and the cities along the route of the line. Our report showed that such a line was not feasible as it could not be financed due to the relation between the cost of the line and the character of the market, which had a very low load factor.

In 1945, my partners, Dr. Brokaw and Mr. McKee and myself and our associates, Mr. Hand and Mr. Logan, began a study of the possibility of serving the Pacific Northwest area, including Vancouver, British Columbia; Seattle, Washington; Portland, Oregon; and adjacent market areas, with natural gas. We looked into gas supply, markets, practicability of route, availability of material, the legal phases resulting from the fact that permits would have to be obtained from several governmental bodies, and the probability of being able to obtain the necessary financing. We studied the possibilities of gas supplies from northern California; western Kansas; Wyoming and Montana.

In 1946, the Northwest Natural Gas Company was formed, the stockholders being my four associates and myself. Beginning in 1946 we have been studying the routes from Alberta to the coast. We studied a route through Kicking Horse Pass to Kamloops and down the Fraser Canyon. This route is entirely impracticable as there is no space in part of the Canyon where a line could be placed and maintained. We studied a route going through Banff, then south through

Radium Hot Springs, Windermere, Cranbrook, Nelson and Trail. This route is also impracticable due to the difficult terrain.

At the hearing before the Standing Committee of the House of Commons on Railways, Canals and Telegraph Lines at Ottawa on Thursday, April 27th, 1950, I was questioned about what studies we had made of a route from Edmonton through Jasper Park, Yellowhead Pass, Kamloops, Princeton and Allison Pass. I told the committee that after a cursory inspection I had discarded this route in favour of a route further south because of its remoteness from Trail and the impossibility of serving that important market from a line through the Yellowhead Pass. We never have made a thorough study of the route, but I assured the committee that before we go to the Board of Transport Commissioners we will make a thorough study of such a route through the Yellowhead Pass and prepare estimates of markets and cost of construction and maintenance. This we propose to do this summer.

(Go to page 20.)

We studied a possible route from Vancouver to Princton, through the Allison Pass and then going in the general direction of the road to Greenwood, Grand Forks, Rossland and Trail. Our engineers went across this possible route on foot and horseback from Creston back to Trail. This is a difficult route as it is in the mountains for a great part of the way. We also studied routes going in and out of Canada along the International Boundary. We have had surveys made of five routes from Alberta to the West Coast and will make a survey of the Yellowhead route. The southern routes all leave southern Alberta via the Crowsnest Pass. The most practical and economical is one which goes through the Crowsnest Pass and then turns south near Kingsgate to a point near Spokane, thence west to a point north of Seattle with lines north to Vancouver and south to Portland. There is no question but that such a route across the state of Washington is by far the cheapest to construct and easiest to maintain. And it is the shortest from Alberta to Vancouver.

We are prepared to build any one of the six which may be approved by the appropriate authorities.

Early in 1948 we concluded that there were gas fields in Alberta with ample reserves, available markets of sufficient size and a physically feasible route, and that the project had all the elements to insure a successful pipeline project. Up to that time, all expense of the undertaking had been borne by the five original stockholders of the company, but we then felt that the project was sufficiently far advanced to justify participation

by others. In February, 1948, we invited a small group to join us to help furnish the necessary additional preliminary capital.

Up to the time all permits have been obtained and construction is about to be commenced, all expenses of the three companies will be borne by the group who organized it, and their associates. No securities have been sold to the public and none will be sold to the public until after all permissions to build and operate the pipeline have been obtained. Associated with us now are Canadian and United States banking firms which will underwrite the securities to raise funds to build the proposed pipeline.

During 1948 and 1949, we retained independent engineers to study the various proposed routes of the line. We made detailed surveys of the possible markets, of available gas reserves, made contracts for the purchase of gas, and made studies of construction costs and operating earnings.

Our plan of a gathering system in Alberta for natural gas will permit the gathering of gas from the Jumping Pound and Pincher Creek fields, the fields in southeastern Alberta, Leduc and other oil fields in central Alberta, and the region to the north and northeast of Edmonton. In fact, we propose to gather gas from most of the gas fields in Alberta except those connected with the pipeline system serving Edmonton which has a gas reserve adequate for all the possible needs of Edmonton for many years to come. Our system can be connected with the pipe-

lines of the Canadian Western Natural Gas Company Limited, which now supplies Calgary, and then, as the Turney Valley gas field gradually is depleted, these other sources of gas will be immediately available to make up the deficiency.

If such a grid system is not built, pipelines must soon be constructed to other fields than those now connected in order to supply Calgary. The cost of supplying gas to Calgary alone would be far in excess of the incremental cost of supplying gas through a system that also has an export market and derives its gas chiefly from the fields in southern Alberta. We believe that we will be able to transport gas from fields in Alberta to Calgary at a transportation cost of 3.5 cents per M.c.f.

In addition to making large reserves of gas avilable for the consumers in Calgary, our grid system will make it possible to serve communities such as Innisfail, Olds, Didsbury, Carstairs, Crossfield, Cardston and Blairmore and Coleman, if a southern route is built to the coast, and other smaller communities which are not now served with natural gas and which otherwise would not get it owing to distances from the sources of supply.

The communities of Exshaw,, Canmore, and Banff, which are not on our grid system, should also be served with natural gas and we are prepared to build a line to serve them.

The grid system will be adequate to supply all of the demands of the communities mentioned above as well as having gas for export. The Alberta consumer will be protected in regard to price and supply.

If a considerable outlet for gas is made available, such big potential fields as Jumping Pound and Pincher Creek can be developed and put into production. In Pincher Creek large amounts of distillate are associated with the gas. This distillate cannot be produced without producing the gas, and the gas, once produced must either be marketed or wasted as returning the gas to the underground formation is not feasible in Pincher Creek. Developing the Pincher Creek gas distillate field will be equivalent to adding a rich oil field to the resources of Alberta.

By providing a pipeline market for natural gas at fair prices, exploratory drilling throughout Alberta will be greatly stimulated. It will require the construction and operation of a large absorption plant, costing millions of dollars, creating a new industry in the Province. At present, the possibility of the discovery of a new gas field is not an incentive for exploratory drilling. With a market for gas, the wildcatter will be encouraged as he will know that if he misses oil, but gets gas, he will be able to sell it.

The whole history of natural gas development shows that the export of gas from the area of production does not decrease the supply of gas available for local consumption. On the contrary, under the stimulus of export markets, increased exploration and development has always resulted in greatly increasing local supplies. The expanding discovery and production of gas in Alberta, together with the construction of a grid pipeline system,

will add to the security and long continued supply of natural gas for Calgary, and, as pointed out above, make gas available to many other communities in Alberta. Competent geologists agree that the potentialities of the gas and oil reserves of Alberta have hardly been scratched. All that the wildcatter needs to keep him adding to the present developed reserves is the incentive of a profitable market. Millions of untested acres still await the driller willing to take the gamble of drilling in unprove territory.

In providing a profitable export market for gas and thus stimulating the increased discovery and production of gas, a situation is created for building up a chemical industry in Alberta. Natural gas, as produced from the ground, contains four principal components: methane, ethane, propane and butane. The raw material mainly desired by the chemical industry is not the methane or ethane (which constitute about 90% of the total volume of gas as produced) but the butane and propane, which amount to less than 10% of the total gas volume. Large quantities of cheap propane and butane will be available for chemical use in Alberta only if a large pipeline is built to use the 90% of methane and ethane. The fear that the export of gas will build up chemical industries outside of Alberta, which might otherwise come to Alberta, is unwarranted. Propane and butane will not be exported by the pipeline. The cost of the methane and ethane, after it leaves Alberta, to the limited extent it is usable for chemical purposes, would be too high to compete with methane and ethane from gas fields

in the United States where gas would be cheaper and freight rates more favourable than along the northern border of the United States or in British Columbia.

The export of gas would obviously give increased royalties to Alberta, both from the gas sold and the attendant distillate, natural gasoline and oil produced with the gas. There would also be the local taxes on the pipelines and processing plants. There would be increased employment from the drilling of wells for gas, building of pipelines and operation and maintenance of plants after construction.

Any one of our five southern routes will be able to serve enroute, by lateral lines, the town and smelter at Trail, and the towns of Fernie, Cranbrook, Kimberley, Creston, Rossland and Nelson, British Columbia; Spokane, Washington; and the route through Washington can serve the atomic energy plant at Hanford, Washington. The Yellowhead Pass route would be able to serve Kamloops, Princeton and Hope, but could not serve Trail, Hanford, Cranbrook and nearby towns. At a point near the Coast, a southern line could be split, a 22 inch main line to Vancouver would serve the British Columbia Electric Company with natural gas for distribution, and a 20 inch line going south to serve distributing companies in Seattle, Washington; Portland, Oregon, and other users along the route.

All of our southern routes offer many obvious advantages over the Yellowhead Pass route which starts near the southern border of Alberta and then goes north, then west, then south, then west to Vancouver and south across the

border into Washington and Oregon. Not including the customers in the region around Vancouver and the Pacific Coast area of the United States, which all pipeline routes propose to serve, any of our southern routes would supply gas to 32,000 people in non-metropolitan areas of British Columbia, as compared to 15,000 people in that province who could be served by the northern project. Any of our southern routes would supply 3.7 million cu. ft. of gas per year to industries at Kimberley and Trail, in British Columbia, as compared to only 1.2 billion cu. ft. which could be supplied to British Columbia outside of the Vancouver area by the northern line. Our southern routes would also serve 14,000 people not now served with gas in Alberta.

Gas can be delivered cheaper to the customers while a higher price can be paid to the Albertan producers by a line following our most southerly route than any of our other southern routes or a line going through northern British Columbia. A higher price to the producers will stimulate exploration and development as well as give the royalty owner (principally the Albertan Government) more money.

It is admitted by all that to deliver gas to Vancouver, a large volume of gas, approximately 75% of the total, must be sold in the United States. If our most southerly route, which would cross Washington, is followed, Canadian consumers will have exactly the same protection for their supply of gas as they would get from a branch line off of a main line built through British Columbia. The physical protection is greater because this most southerly route can

surely be maintained throughout the year and the legal protection is exactly the same. If we are authorized to build the line via Washington, we plan to have the Canadian customers at Trail and Vancouver, New Westminster and other British Columbian points take title to the gas before it leaves Canada. It will be the property of the Canadian purchaser before it leaves Canada to be delivered back to him in Canada. There would therefore be no way to divert this gas for use in the United States. We plan facilities more than ample to supply Vancouver's anticipated needs.

The southern route, more of which is in the United States, is cheaper to construct and maintain, and has less chance of interrupted service. The volume of gas through the line would be greater as the facilities could be used at or near capacity more of the time, larger volumes of gas could be sold at a lower total capital cost and prices of gas would be lower.

It must be remembered that no line could be built to serve British Columbia without the United States market and the more gas that is sold in the United States the cheaper the gas will be in British Columbia. The route of the line in British Columbia and the United States has the direct effect on Alberta in that more effective transmission facilities at lower cost will permit higher prices to be paid for gas for export from Alberta.

We assume that any line built will be financed without government aid. Private capital for this, or any other enterprise, can be secured only on terms which seem reasonably attractive to the private investor. We also

assume that gas lines are or will be regulated by public authorities so that the rate of earnings will be limited to a fair rate of return on the total capital invested. The prerequisite of any such investment is security of return. Some gas for domestic and commercial use can be sold for high prices. Such sales involve low sales in summer and high in winter, but no long distance gas transmission line can be built and paid for on such a load. Gas must be sold in large volumes for industrial use and this industrial gas must be priced to compete with other industrial fuels. A backing of a proven adequate volume of sales as well as sufficient reserves are essential before any line can be financed. Gas sales in large volumes in the United States are a necessity for any pipeline to the coast and I repeat, the larger the volume of these United States sales, the cheaper the gas can be sold in British Columbia.

The chief competing fuel in the Pacific Northwest is fuel oil. Prices of fuel oil are such that it is possible no other gas line except the cheapest can be financed and built.

The cost of a pipeline is not necessarily a major concern for the initial investors, if the conditions are such that the gas can be bought, transported and sold so as to yield a fair return as determined by the regulatory authorities. The profits are limited and the return fixed by the capital costs. The producers of gas, the consumers of gas, or both are the parties adversely affected by high capital costs with attendant high costs of transmission and high sales prices. In other words, without a price for gas which will secure an adequate market there will be

no pipeline, and consequently gas consumers, gas producers and investors will all suffer.

The southern routes would supply the industries of Trail and Kimberley, which the northern line does not touch. In addition, our Washington route makes it possible to serve the atomic energy plant at Hanford, Washington. This service is in the public interest, not only of the United States, but of Canada, and must be taken into account as an important contribution to the defence of the continent.

The benefits to Alberta and British Columbia would be reflected in the rest of Canada. We are negotiating with the Dominion Bridge Company, Limited, which plans to start a pipe mill in Canada, perhaps in Calgary, to fabricate pipe over 16" in diameter. They have given us a tentative quotation. Pipe 16" and smaller is now available in Ontario. We expect to purchase the compressors as well as other machinery and materials in Canada for the Canadian part of the line.

I would like to put in here a letter which I received which this was written from the John Bertram & Sons Company Limited, machine tools, Dundas, Canada:

"Mr. F. A. Dixon, President,
The Northwest Natural Gas Company,
120 Broadway,
NEW YORK, N.Y., U.S.A.

Dear Sir:

We wish to advise you that our various conversations and discussions with the Cooper-Bessemer Corporation of Mount Vernon, Ohio, regarding manufacturing for their account, their Model GMV-TF

"Engine Driven Compressors which range in size per unit from 440 to 1350 Horsepower, have brought us to the point where we have reached an agreement.

We are well equipped and qualified to build the above mentioned Compressors and expect our prices to be competitive. We will be delighted to have an opportunity to manufacture the Compressors required for any projects involving compressor equipment.

Yours very truly,

THE JOHN BERTRAM & SONS COMPANY, Ltd.

/s/ N. T. FINLAYSON

Vice President and General Manager."

MR. NOLAN: Perhaps that letter could be given a number, Mr. Chairman. It would be 3.

THE CHAIRMAN: Exhibit 3.

LETTER FROM THE JOHN BERTRAM & SONS COMPANY, LTD. TO MR. F. A. DIXON DATED MAY 24th, 1950, PUT IN AND MARKED EXHIBIT 3.

THE WITNESS: Various Canadian firms have agreed to act in different capacities. They include The Royal Trust Company and Lloyd's Register of Shipping, Montreal. It is expected that the smaller diameter pipe will be supplied by Page-Hersey Tube Company, Welland, Ontario.

A strong group of responsible banking firms in Canada and the United States, headed by Morgan Stanley & Co. of New York City, are prepared to arrange for financing in an amount sufficient to pay for the construction of the entire pipe line system. Canadian investment bankers who have agreed to be associated with the financing

are: A.E. Ames & Co. Ltd., James Richardson & Sons, Tanner & Co., the Dominick Corporation and Greenshields & Co.

No matter what other advantages might accure, Alberta has by the recently enacted laws, made certain that there will be no export of gas, if any such export should threaten the gas supply available to the people and industries of Alberta. There are two things that seem assured regarding Alberta: immense discoveries of additional oil and gas, and great increases of industrial development. The exact amount of increase of either is not susceptible to exact quantitative engineering analysis; but, judging the future by the past, the rapid rate of new discoveries of oil and gas will continue at an accelerated pace, and new industries not now foreseen will spring into being.

We believe that the indicated proven gas reserves of Alberta are now more than sufficient to take care of the present and future needs of Alberta. We believe by exporting surplus gas, as contemplated by our present application, this enterprise will aid in the security and abundance of gas at low prices in Alberta, and will encourage and adequately reward the producer and royalty owner, and will be a help in the industrial development of the Province.

Q MR. NOLAN: Mr. Dixon, I observe on the top of page 2 of Exhibit 2 you state that you have petitioned for a special Act of the Parliament of Canada to incorporate the company to be called Alberta Natural Gas Company. That application or petition was made under the Pipelines Act of the Parliament of Canada, was it not?

A Yes, sir.

Q What progress has been made?

A That has now passed the House and has passed the Senate, and is now awaiting Royal assent, which may be given today.

MR. NOLAN: That is all I am going to ask Mr. Dixon. As I said, sir, he will, of course, return to the stand on a number of occasions when he gives evidence pertaining to these various topics which I have mentioned. Perhaps it would be well now if I proceeded to call the evidence in the case, and that I will do by asking Mr. Slipper to come forward.

MR. C.E. SMITH: I wonder before Mr. Nolan lets Mr. Dixon go if I might ask Mr. Dixon one or two questions, sir?

Q The opening, as it has been called by your counsel, Mr. Dixon, I suppose in a small way covers a vast amount of material, does it?

A Yes, sir.

Q And the Board and the gentlemen around here, can they assume that with respect to everything said in your opening there will be at some later date an opportunity to examine either yourself or other witnesses with respect to those particular matters?

A Yes. This is just a summary of what I expect to prove.

Q It may be a summary, but it is going on the record as evidence and may be led by other people at some time, and I would like to make certain everybody has an opportunity of cross-examining somebody on everything you have said in this. Is that correct, Mr. Dixon?

A That is correct.

Q MR. FENERTY: There are one or two questions I would like to ask just by way of preliminary so that we will have a clearer understanding of what is going to come up, if

I might. Mr. Dixon, you say on page 6, "In fact, we propose to gather gas from most of the gas fields in Alberta," excepting certain fields. Now, I see on the agenda that Mr. Slipper will be the next witness, who is going to give us a very comprehensive report on the gas fields of Alberta. I am wondering whether, before Mr. Slipper goes on the stand, you can furnish us with a detailed statement by name of most of the gas fields in Alberta that you intend to gather gas from, because I do not want to bother cross-examining Mr. Slipper with reference to fields you are not going to gather gas from. Would it be possible to give us those fields in detail, or would you have to give it later?

A I would think it would be much better to give that at the time I am giving the design of the line. It makes it more intelligible then. It will be built up to that point. We will describe the fields. Mr. Slipper will in his evidence testify to the quantity of gas there, then I will testify in regard to how we are going to get the gas out.

Q You do not think you could give us the fields in advance?

A I do not think that would be satisfactory to anybody, to do that.

Q I would hate to spend half a day perhaps in discussing with Mr. Slipper points that you later will say, "We are not interested in that field".

(Go to page 34)

A The only field that we are not at all interested in is Turner Valley - well, we will do it by exception. We are interested in every field except the fields that now supply Edmonton and Calgary.

Q You are not interested in them?

A We are not interested in those fields.

Q And unless something unexpected develops you expect to be able to say sometime during this enquiry where you are going to get your gas?

A Yes.

Q And do you feel you cannot say that until after we have had other evidence?

A I think it would be better if we could do that later. I could run over them in a very general way if you wish me to. This is the information generally, I think. It will be Pincher Creek, Jumping Pound, the Pendant d'Oreille region, the area in which Standard of California has large holdings, and the country from Leduc to the north, and possibly Stettler. We cannot hope to be starting on this enterprise for another year and there will be a great deal of development between now and then, and it looks like where we definitely will be able to run our line will be a region which will be developed. There will be additional supplies from all fields in Southern Alberta and into a region say 50 or 100 miles north of Edmonton.

Thank you. Then something that is on page 7. I find two references to some matters that I have been hoping to hear something about since even before the Dinning Commission report. I want to ask you whether you propose to give us some detailed reports, including facts and figures, with

relation to these matters. The second paragraph.

"The cost of supplying gas to Calgary alone - -"

A On what page do you say?

Q The second paragraph on Page 7?

A Oh yes.

Q And the second sentence.

"The cost of supplying gas to Calgary alone would be far in excess of the incremental cost of supplying gas through a system that also has an export market."

I take it that is at the moment a general statement?

A Yes. We will give a detailed statement later.

Q And you will have the facts and figures showing the differences?

A We can show what we consider the cost will be for our system but we cannot figure and give the cost of someone else's.

Q But you will be able to show us figures which show us why that statement is correct?

A Yes, sir.

Q And you will necessarily have to deal with cost if there is no export?

A Yes.

Q That is one thing I have been inviting people to show for some time. And then at the bottom of the same page, and this is the $64.00 question of this whole enquiry, as far as I am concerned:

"The Alberta consumer will be protected in regard to price and supply."

You are going to show us that in detail?

A I hope to.

Q It is a hope?

A I think I can.

Q And we hope you will be able to show us where we will be protected, both in regard to supply and price?

A Yes.

Q You are going into that in detail as to how we will be protected?

A Yes.

Q There is another one that I had in mind there but I will leave that to my friend Mr. McDonald. I feel that when two forces here get through examining you we will be followed by other counsel.

MR. C. E. SMITH: And I hope you two will be able to agree on what "protected" means, that is, Mr. Fenerty and Mr. Dixon.

MR. FENERTY: I am very reasonable.

Q THE CHAIRMAN: Do you intend to give evidence in regard to the design of the pipelines and deliverability and so on?

A Yes.

Q You will recall the Westcoast hearing, having been present at those hearings, that the Board placed considerable importance on that end of it?

A I will try and give you this but we thought it would be better to go in when we are dealing with the design of the line.

Q You will give evidence as to deliverabilities in the fields you intend to take from at that time?

A Yes.

THE CHAIRMAN: There is one other matter, Mr. Nolan, and that is the matter of contracts. They have not been touched on either by yourself or Mr. Dixon, and I wonder if you intend to give us any evidence as to that?

MR. NOLAN: We could make a statement as to that now.

A Yes, we will tell you about all the contracts that we have and those we expect to make.

MR. NOLAN: We did, of course, with the application file with the company material certain of those contracts.

MR. C. E. SMITH: Have you read them lately?

THE CHAIRMAN: They are out of date.

MR. NOLAN: I know, but we will bring matters up to date. Now if that is all, I will call Mr. Slipper, sir, and go ahead with our evidence.

STANLEY E. SLIPPER, having been duly sworn, examined by Mr. Nolan, testified as follows:-

SUBMISSION BY S. E. SLIPPER, ON BEHALF OF THE NORTHWEST NATURAL GAS COMPANY AND ALBERTA NATURAL GAS GRID LIMITED NOW MARKED EXHIBIT 4.

MR. NOLAN: Have you been sworn?

A Yes.

Q Would you give me briefly, please, your qualifications?

A I am a graduate of Queen's University in geology. I have been in Alberta almost exclusively since 1914, working on the natural gas geology of the Province.

Q As opposed to the oil geology?

A Well, I should not say that. I might say that my major interest was in natural gas.

Q Have you had occasion to estimate the reserves of gas?

A Yes, I have.

Q For your employers, both corporate and private?

A Yes.

Q And you have prepared a report for this Board which has just been given a number, Exhibit number 4, and perhaps you would be good enough to tell me how this report is built up, so that it will be more convenient both for the Board and for counsel to find their way through this document?

A The submission I am presenting on the natural gas reserves of Alberta places emphasis on the geology of the gas accumulations in the Province.

Q And when I say that, you have classified the strata into five groups and that we will find these groups on page 2, table 1 of the document?

A That is right.

Q And each of those groups is subdivided into what I might call horizons?

A Yes. The division into groups is the natural division of the stratigraphy of the Province based on the four erosion intervals and based on five sedimentary divisions.

Q Yes?

A I have described those more in relation to natural gas geology and also very briefly, and the report proceeds from there on with a division of those groups into natural gas horizons that are found within them. Starting at the surface and proceeding downwards.

Q In other words, group 5 is the top one?

A Is the top one.

Q And you go down through 4, 3, 2 and 1, discussing in detail these various horizons in those numbered groups?

A Yes, and I proceed and deal with those with a series of maps that are numbered in the report from 2 to 8. Each map

recognizes each important gas division in the stratigraphy.

Q And those are at the back of the report?

A Those are at the back of the report.

Q They are numbered 1 to 8?

A Numbered - there is a map No. 1, which is a composite map showing all the gas horizons and maps numbered 2 to 8 deal, each one deals with a particular gas horizon.

Q And what are these pages which are called Figures. I find you have Figures 7, 8 and 9 immediately preceding the maps, Mr. Slipper. What are they?

A They are the columnar section showing the vertical position of the gas horizons that are shown in the horizontal areal view of each one of the maps.

Q Yes, I see. Well now, is it correct to say that your approach to this task has been upon a geological basis?

A Yes, rather than an engineering basis.

Q Rather than an engineering basis?

A Yes.

Q And what you are doing, as I understand it, is to take each horizon that exists, explain to the Board what gas is either proven or probable or potential in that horizon?

A That is correct.

Q Irrespective of fields?

A That is right.

Q But in the end you do make a summary, do you not, a re-capitulation?

A A recapitulation.

Q Where is that to be found?

A That is on Page 28 in Table 6.

Q That is entitled "Summary and Conclusion"?

A That is right.

Q There again I see that you are talking about these various horizons?

A Yes, they are classified in the recapitulation.

Q You have a table prepared and we might mention the figure now of gas reserves for Alberta of something in excess of 12 trillion?

A That is correct.

Q Cubic feet?

A Yes.

Q With that explanation, Mr. Slipper, I think I will now ask you to read your report, if you will, please?

A <u>INTRODUCTORY STATEMENT</u>

Estimates of the potential, probable and proven reserves of natural gas in Alberta have been offered in evidence by other geologists and by engineers during the sittings of the Conservation Board to consider applications for export licenses. I propose to approach the subject of gas reserves from a somewhat different viewpoint than has been presented hitherto.

It is my intention to describe the natural gas geology of the Province. I believe this is desirable in order to support the opinion of most geologists that the gas resources of Alberta are of such magnitude that permission to export gas will not jeopardize our domestic supplies.

As a foundation, some introductory description of the historical geology of Alberta will be required, though in abbreviated form and limited by its relevancy to the occurrence of natural gas.

<u>STRATIGRAPHY OF ALBERTA</u>

The great depth (up to 16,000 feet or more) of

sedimentary strata in Alberta are divided by four natural breaks or discontinuities. These divisions do not exactly conform with those of the standard geological table, but provide a natural separation of the strata into five groups containing different kinds of deposits. The discontinuities represent intervals of non-deposition.

TABLE 1 SHOWING ALBERTA STRATIGRAPHY

	Standard System	Character
GROUP 5	Oligocene Eocene Paleocene	Lake and Delta and outwash plain deposits of sandstone and shale. Any natural gas is almost pure methane.
	EROSION INTERVAL	
GROUP 4	Upper Cretaceous Lower Cretaceous Jurassic	Represented by deposits of six advances and retreats of Intra-continental seas. Regressive deposits of sand beds and transgressive deposits of marine shale. Natural gas high in methane with ethane and heavier hydrocarbons increasing with depth and decreasing eastward.
	ANOTHER EROSION INTERVAL	
GROUP 3	Triassic Carboniferous Devonian	It is all marine. Chemical and biochemical precipitates of limestone, dolomite, evaporites of salt, gypsum and anhydrite - Natural gas, high in ethane plus, gasoline, sour, (Hydrogen Sulphide) carbon dioxide.
	EROSION INTERVAL	
GROUP 2	Ordovician (?) Cambrian	Various sandstones and shales in the northeast and Marine beds in far west - natural gas, high in ethane plus, gasoline.
	EROSION INTERVAL	
GROUP 1	Pre-Cambrian	Granites and other igneous rocks in northeast called the igneous complex and quartzites, shales and crystalline limestone in the southwest. No natural gas.

GROUP NO. 1 OF TABLE

The Pre-Cambrian formations consist largely of igneous rocks, which underlie all the others and are thus often called the basement complex though in the vicinity of Waterton Lakes there are pre-Cambrian strata consisting of slates, quartzites and altered limestone. In the southwest area some oil and shows of gas have been found in the Pre-Cambrian. This oil and the gas migrated through faults from younger formation. The Pre-Cambrian is of no interest from the standpoint of natural gas reserves.

GROUP NO. 2 OF TABLE

The beds in Group 2 lying unconformably on the basement are of Cambrian or possibly Cambrian and Ordovician age. These consist, in the northeastern part of the Province of coarse red and white sandstones and red and black shales. Some gas and distillate have been found in the Cambro-Ordovician in the foothills, in the Clearwater and Moose mountain areas, and some oil shows at Elk Point. The thickness of this group of strata varies from nothing in the northeast to a thickness of some 16,000 feet in the Mt. Eisenhower and Field, B.C. area.

The importance of the Cambrian group is unknown, and while generally discounted, the possibility of gas supplies being developed therein cannot be definitely dismissed.

GROUP NO. 3 OF TABLE.

Group No. 3 includes the Devonian Carboniferous and Triassic limestones, dolomites, gypsum, salt and anhydrite beds with some thick shale sections. The whole group is essentially a very thick accumulation of limy strata. The Triassic contains thick members of light colored siltstones,

but otherwise is largely limestone.

The known and potential gas accumulation in Group No. 3 is probably greater than that of any other section of the Alberta stratigraphic column. Turner Valley, Pincher Creek, Leduc, Jumping Pound are all within it.

GROUP NO. 4 OF TABLE.

Group No. 4 is an entirely different type of sedimentation than that of Group No. 3 in that it contains no important limy beds (except for some impure limestones in the Jurassic). The sediments were deposited in a series of rythmic advances and retreats of a mediterranean sea. The sea advanced from the north and from the south while the sediments that form the strata were brought in from the west. We thus have an alternating arrangement of thick marine shales interlarded with sandstone wedging out in an eastward direction. The source of most of the natural gas in Group No. 4 had its origin in the organic remains in the marine shale, while the intercalated sands formed the gas reservoirs. Our great blanket sand gas fields of Medicine Hat and Viking, and in fact practically all gas fields except those of Group No. 3 are within Group No. 4.

In general, the total thickness of Group No. 4 increases westward, but over the Province there is probably about 6,000 feet of strata.

GROUP NO. 5 OF TABLE

None of the Tertiary strata of Group No. 5 is marine. Most beds were deposited in fresh or brackish water lakes. There are a few small gas occurrences. The Tertiary formations do not contain important gas zones.

RELATION OF STRUCTURE TO ALBERTA GAS RESERVES

In the foothills and in small areas along the United States boundary, the structural trap type of gas accumulation such as the anticline is important. Over the Plains area gas accumulation is largely dependent on stratigraphic traps by which we mean sand lenses or other barriers formed by changes in the character of the sedimentation. The coral reef or bioherm is also a form of nonstructural trap.

Frequently, the elements or dimensions of a structural trap can be measured and the gas accumulation therein can be estimated with more or less confidence in the preliminary stages of development. This is not so, however, with stratigraphic traps. It is seldom that a sand lense or a coral reef is mapable with entire confidence either by geological or geophysical methods until development has reached an advanced stage so as to furnish data on the length and breadth of the reservoir. As an example, the Pincher Creek field is a structural trap which has been outlined by a seismograph survey. Only three wells have been drilled. These have proved the occurrence of gas and defined the water level. By combining these few but significant data, a reasonable estimate of the gas reserve has been calculated. On the other hand, the Viking-Kinsella Field, a stratigraphic type of field, had been producing for twenty years before the areal extent of the field could be determined.

GAS ZONES IN ALBERTA

The foregoing is a greatly abbreviated description of Alberta stratigraphy from the basement complex up to youngest sediments. Using the series of Maps Nos. 1 to 8

inclusive, which are arranged in downward succession through the stratigraphic column, the various gas zones will be discussed in some detail. The composite Logs Figures 7, 8 and 9 also showthe sequence of the gas zones.

MAPS OF GAS ZONES

Map No. 1 - Gas fields and individual gas wells in Alberta as of March 10, 1950.

Map No. 2 - (a) Surface gas springs and seepages.
(b) Tertiary gas.
(c) Milk River formation gas.

Map No. 3 - (a) Medicine Hat gas.
(b) Lloydminster gas.
(c) Blackleaf gas.

Map No. 4 - Lower Cretaceous gas.

Map No. 5 - Jurassic gas.

Map No. 6 - Triassic gas.

Map No. 7 - Carboniferous gas.

Map No. 8 - Devonian gas.

Q Map No. 1 is a composite map?

A Map No. 1 is a composite map. It contains the information on the other maps.

Q And then just looking at Map No. 2 which has this very broad black line described as the Tertiary boundary. Does that indicate the limits of that particular strata?

A That indicates the boundary of the strata that are classified as Tertiary.

Q Yes?

A And the area within the black line is of course the area that is outlined.

Q I look for an X and find gas seep?

A Yes. The surface gas seepages that I know about are shown by a cross, a black cross, and the gas fields in the Tertiary

. .

are shown by open circles.

Q What does this mean when you say "Line of first overthrust"?

A Line of first overthrust, that is the first heavy faulting in the formation of the Foothills and the Rocky Mountains. West of that line the rocks are highly disburbed. East of it they are more or less gently folded.

Q If you will look at Map No. 3 with me, which is a map showing the Blackleaf depositions?

A Yes.

Q I see that the northern limits - -

A That is the northern extent of the Blackleaf base.

Q So that everything south of that northern limit or boundary is in this formation?

A Has Blackleaf formation, yes.

Q Has Blackleaf formation in it, and the gas there is - -

A The gas fields are shown in black. The boundary of some are shown by a dashed line. The boundary of the Medicine Hat field is shown by a dashed line and the southern boundary of the basal Coloarado is also dashed and the Blackleaf at Princess is shown by a half circle. The boundary of the Viking Sand gas in Redwater is shown by a dashed line.

Q Now, looking at the next map which would be Map No. 4. We are talking there about the Lower Cretaceous?

A That is the Lower Cretaceous deposition, yes.

Q Blackleaf is Upper Cretaceous?

A Blackleaf is Upper Cretaceous, yes.

Q So we are still in this Group 4 you described on Page 2?

A That is right.

Q I see something called McMurray truncation and Grand Rapids truncation?

A The Lower Cretaceous is made up of a number of different

sands alternated with shale. At the base of each there is a sandstone that lies on top of the radius surface of the limestone which induces the Lower Cretaceous, and then the basal, which sand in gas geology is quite important. So that it is treated quite extensively on any report on gas. That Grand Rapids truncation, you might say, is a truncation of the upper sands of the Lower Cretaceous.

Q What is a truncation?

A That is where it has been eroded off at its limit.

Q Where it peters out, so to speak?

A It is cut off. And the McMurray truncation shown there indicates a truncation of the basal sands of the Lower Cretaceous.

Q And you have indicated on the map the proposed gas wells?

A Yes, gas wells, and the notes are there giving the information.

Q Yes, giving the information. Then looking at No. 5. You are talking now about the Jurassic. We are still in Group 4 aren't we?

A Yes, we are still in Group 4.

Q That is the lowest strata in Group 4?

A As I have divided them.

Q You have the Jurassic truncation here?

A Yes.

Q As I understand it, everything that lies below that line is in that formation?

A No.

Q Everything above it?

A The Jurassic formation exists west of that line. It does not exist east of that line. It has been worn off.

Q Yes, I see. As a matter of fact it comes pretty close to the mountains, doesn't it?

A Yes, it is very close to the mountains.

(Go to page 49.)

Q Well, then, the next one is No. 6?

A By the way, that map, the potential gas area of the Jurassic is shown by a dashed line in the southeast corner.

Q In the lower righthand corner of it?

A Yes.

Q Now, in what group is that?

A Group 3.

Q To Group 3. That is the Triassic, and you have.....

A I have a line showing, as it did in the Jurassic, the eastern boundary of the Triassic deposition. There is not much gas in the Triassic, so far as we know it. There is a slight amount of it in the Northwest Peace River area, but otherwise there are no gases in the Triassic. That is the beginning of my Group 3.

Q Yes? And then you go to the Carboniferous in Map No. 7?

A Yes. And the line marked "Carboniferous Truncation" is the same there as in the other previous maps. That is the eastern boundary of the existing Carboniferous deposition.

Q And the gas that is to be found in this particular strata is indicated on this map by these black spots?

A Yes, the different fields there.

Q And finally, Map No. 8, is the Devonian?

A Yes.

Q That is still in Group 3, isn't it?

A That is still in Group 3, yes.

Q And there are one or two gas fields in the vicinity of Leduc. Leduc is in this Devonian?

A Yes, Leduc is the only large gas field known.

Q Now, we leave that particular group, which was 3, and go to Map No. 9, to Group 2, do we?

A Well, these maps - No. 9 is simply a map of a gas field.

Q In the Viking-Kinsella field?

A Yes, that is right.

Q And what is Map No. 10?

A Map No. 10 is a map of the Medicine Hat field.

Q Yes?

A Map No. 11 is a map of the Pakowki-Manyberries area.

Q And 12 is the map of the Princess field?

A The Princess field, yes.

Q I think it would be convenient now, Mr. Slipper, to look at the figures, if you would,please?

A Yes.

Q What you describe as your Figures 7, 8 and 9. They are logs, are they?

A Yes, logs. They are composite logs to indicate the vertical relationship of the different gas horizons.

Q I suppose they are self-explanatory? But looking at the first o one, that is Figure No. 7?

A Yes.

Q And looking on the lefthand side, that is Southern Alberta?

A That is a typical log of Southern Alberta stratigraphy.

Q We are talking about the Upper Cretaceous. And I see marked against that log the words "Brooks Gas Zone about 200 Mcf".

A Yes,

Q And it is by a notation such as that that you indicate here the gas is to be found in that particular log?

A That is right.

MR. C. H. SMITH: Which one are you looking at now?

MR.NOLAN: I am looking at Figure 7, and I am looking at Southern Alberta, and I was referring to the log

at the left, and I was drawing the witness' attention to halfway down on the righthand side of that log, Southern Alberta, to show how the presence of gas is indicated. And they are all shown by these logs on that same basis?

A That is right.

Q But they deal with different strata?

A Yes. Well, now, just to the right of that log of Southern Alberta is a short column showing the Jurassic of Pinhorn area. That is a log of the sediment in the Jurassic in the Southern part of Alberta. It is different than what is shown on the rest of Southern Alberta, so that a separate short log is shown to indicate that stratigraphy.

Q This is a peculiar formation?

A That is unique. That is unique in respect of the rest of the Jurassic.

Q And that is why you set it out by itself, so to speak?

A That is right.

Q Turning to Figure No. 8. It is what it says it is, I suppose, a composite log of the Carboniferous and Devonian formation?

A That is right.

Q Again built up on the basis of Southern Alberta?

A Yes. Central Alberta.

Q Central Alberta?

A That is right.

Q And you show "Outer Foothills"?

A Yes.

Q What do you mean by that?

A By Outer Foothills I mean the area that lies east of the very high hills. Around Exshaw would be Inner Foothills, and Outer Foothills would be around Cochrane.

Q And Figure No. 9 is described as being a type section of the Edmonton area?

A Yes. That is mainly to show the position of the Basal Quartz sand, the Viking sand stone, and the general relationship of the Lower and Upper Cretaceous in that area, both of whifh are important there.

Q Of course, you intend to go into this later, in your report?

A Yes, to some extent.

Q This is just for the purpose of familiarizing ourselves with these maps and Figures. Now, you were at the bottom of Page 4 of your report, and had described the maps of the gas zones?

A Yes.

Q Well, now, will you please go back to the top of Page 5?

A Yes.

Q And read from there?

A Yes.

SURFACE GAS SPRINGS AND SEEPAGES

On Map Figure 2 the better known surface manifestations of gas in the form of springs and seepages are indicated. The gas springs along the river at Medicine Hat led to the discovery of the upper gas sand (the Milk River sand) from which our first gas supplies were obtained. The Turner Valley Field was discovered by drilling on and around the well known gas spring on Sheep River. This gas spring is one of several known to occur along the line of the first Foothills overthrust which extends for 600 miles. With only one-third of this belt intensively explored, three fields (namely, Pincher Creek, Turner Valley and Jumping Pound) with a combined reserve of four trillion cubic feet have been discovered.

It is now known that the gas of these gas springs originates directly or indirectly in the Madison limestones, which is the gas zone of the three fields discovered. There is a reasonable expectation that within the remaining 400 miles of the gas seepage line, which is relatively unexplored, that at least another three or four trillion cubic feet of additional gas reserves will be discovered.

Q Now, with respect to that statement, you wish the attention of the Board to be drawn to this map No. 2?

A Yes.

Q And you say that "The better known surface manifestions of gas in the form of springs and seepages are indicated?"

A Yes, by a black cross on this map.

Q That is the map you spoke of a few minutes ago?

A The cross being the seepages.

Q Yes. And the circles being the gas fields?

A The one that I spoke of as being the originating idea that started drilling for gas at Medicine Hat is shown right at the corner there on the South Saskatchewan River. The Sheep River gas spring is shown just Northwest of Calgary on the map. Two other gas springs are shown near High River, with two more being near Brazeau, and one up in the North West corner.

Q Down in the Medicine Hat area I notice you have three circles of broken lines?

A Yes. Those three circles represent the area of small fields that are developed in the Milk River gas sands, which is outlined by the dashed line.

Q Now, is there anything else on that Map No. 2 that you would like to draw to the attention of the Board?

A Well, the area I suggest contains a great many more gas, or

contains more gas fields than have been found along the foothills is shown by that line of first overthrust. It is along that line that in all probability other gas fields of the same magnitude as those found in Turner Valley and Pincher Creek and so on will also be found.

Q Yes. That line of overthrust goes through the Turner Valley, doesn't it?

A Turner Valley is just east of it.

Q Just east?

A Just west of it.

Q Just west of it?

A Yes.

Q And does that proceed through that line to Pincher Creek where the Gulf wells are?

A Yes, that is right. It is also east of the Pincher Creek field.

Q Yes?

A It is rather northeast of the Pincher Creek field there, because it swings a little.

Q Now, Mr. Slipper, we will go to our natural gas resources in the middle of Page 5, and we begin with Group 5, which is the one closest to the surface?

A That is right.

TERTIARY GAS

The Tertiary beds remaining in Alberta are outlined on Map No. 2. They consist largely of sediments laid down in fresh or brackish waters together with river and land deposits. The environment was generally unfavorable for gas formation. There are, however, a few very small fields or individual gas wells. These wells, important enough to the small commun-

ities or individuals using the gas, are insignificant in the overall estimate.

And then I have a list of Tertiary Gas fields.

Q Yes. Well, now, we find those on Map No. 2?

A That is right, on Map No. 2.

Q The first one you have got is Meeting Creek?

A I will find the map first. That is marked "Meeting Creek".

Q It is about the centre of the Province, isn't it?

A Yes.

Q Northeast of Red Deer?

A Yes, northeast of Red Deer with an open circle.

Q What do you say about Meeting Creek?

A There are two or three small gas wells there. They are of a depth of 370 feet. They supply two or three stores and a few other customers in the town.

Q And you aren't making any estimate yourself on that?

A No.

Q Then you mention Craigmyle?

A Craigmyle is shown with an open circle on the map and is marked "Craigmyle".

Q Northeast of Calgary?

A Yes.

Q And what do you say about that?

A There have been a number of small shallow wells drilled there, probably four or five, giving a small amount of gas. That was developed by a farmer there, who, at one time, thought he might make carbon black out of it.

Q And lastly in this formation you mention High River?

A Yes. Outside of High River many of the oldtimers will remember a gas well along the highway that burned for at

least twenty years or so at the Bird farm, just near the highway. It was blazing there for a number of years. There are two or three other wells of that type there. They all come from Tertiary beds.

Q All right, that is Group 5.

THE CHAIRMAN: I think this might be an opportune time to adjourn for a few minutes.

MR.NOLAN: Yes.

(Hearing resumed after short adjournment).

THE CHAIRMAN: Mr. Nolan, next Monday is a holiday. Now, the Board is prepared to sit on Monday, and I believe we can make arrangements to have the Court Room opened, but we would like to hear the views of other Counsel. I do not know whether you have considered the matter at all.

MR.NOLAN: I had thought about it, but I think I would prefer to mention it a little later in the week, if I may, as I will know better then what progress I am making, and if it is necessary to sit on Monday, of course, I have no objection to it, but it might not be necessary, in which event it would not require the arrangements to be made for the Court Room and for the personnel to be here, because it is a statutory holiday.

THE CHAIRMAN: Yes.

MR.NOLAN: Do I understand, sir, that you are sitting for five days a week?

THE CHAIRMAN: Well, we will sit until Friday.

MR. NOLAN: Not on Saturday?

THE CHAIRMAN: No, not on Saturday. If it becomes necessary at the end of the second week, we are prepared to sit on Saturday.

MR.NOLAN: It is just a little difficult for me at the moment to look forward as far as next Monday because it is difficult to know how long these presentations are going to take, largely because I do not know the amount of cross-examination that there will be, but I would ask the Board to permit me to speak to the question of whether we sit on Monday perhaps in a day or two?

THE CHAIRMAN: Quite.

MR.NOLAN: Thank you, sir.

Q Now, Mr. Slipper, you had been discussing with me the natural gas resources in Group No. 5 on page 5 of your report, and you had explained what there was to be found in Meeting Creek, Craigmyle and High River. Now, the natural gas resources in Group No. 4, and perhaps you will discuss that now, beginning with the Milk River formation gas.

A Yes.

MILK RIVER FORMATION GAS

There are a few localities where gas had been found in the beds of Group 4 above the Milk River formation. One such is west of Warner in Township 4, Range 18, West of the Fourth, as shown by an open circle.

Q On this same map?

A On this Map No. 2.

Q On Map No. 2?

A Yes.

Q We are still on that?

A Yes.

Q Yes. I see that in the vicinity of Warner?

A Yes. One such is west of Warner in Township 4, Range 18, West of the Fourth, and there are old gas wells at Wetaskiwin

and Camrose. Wetaskiwin was supplied with gas for some years from some of these shallow wells, not all of Wetaskiwin but a portion of the town.

One of the interesting high gas occurrences is that from the well in east Calgary, which supplied the first gas used in the city. Drilled in 1909, it has been in use in a small say ever since.

The most important of the shallow gas zones is the sandy shale northeastern margin of the Milk River formation. There is about 200 feet of these beds which are very gaseous. Unfortunately, permeable sands are underdeveloped and on this account well capacities are low. The original closed pressure at Brooks of 365 pounds probably represents the original closed pressure of the whole Milk River gas area. It is much below the normal pressure that would be expected. There are no cores of the Milk River gas sand, but it is known to be very fine grained and contains considerable shale. While there is no free water, the zone contains a high percentage of connate water, and the wells have to be cleaned out frequently. The open flows seldom register over 200 Mcf per day. The areal extent of the gas bearing Milk River formation is outlined on Map No. 2.

We have mentioned it before. Some 25 wells, are indicated but there are probably more. The area outlined contains more than four million acres.

This gas zone is well known, but is never seriously considered as a gas reserve in spite of its very great local value. It is quite correct not to assume that it has value as pipeline gas. However, if the field were situated, say in Ontario, it would undoubtedly be intensively developed.

RESERVES OF MILK RIVER GAS PAY

Area - 4,000,000 acres.

Sand - 200 feet gas bearing; at least 10 feet of permeable zone.

Porosity - effective....

instead of effective I should say net porosity.

...net porosity estimated at 10%.

Pressure - 365 p.s.i. = 25 atmospheres.

Possible gas reserves - 43 560 x 10 x .1 x 25 x 4,000,000.

Assuming 25% recoverable = 1000 MMMCF

Q Now, that formula you set out there, Mr.Slipper, the 43,560 is the number of square feet?

A Per acre.

Q Per acre?

A Yes.

Q And the 10 is the depth of the permeable zone?

A That is right.

Q The .1?

A Is the net porosity.

Q And the 25 is the recoverable?

A Yes. The 25 is number of atmospheres pressure.

Q Number of atmospheres pressure?

A Yes.

Q And the 4,000,000, the number of acres?

A That is right.

Q And you multiply them all together?

A Yes.

Q And you assume a 25% recoverable?

A Yes.

Q Which gives you 1000 billion?

A 1000 billion cubic feet.

Q 1000 billion cubic feet?

A Yes.

Q Now, you have a note here about Brooks, Suffield, Medicine Hat and Tilley?

A Proven reserves according to Hume,- Brooks to 100 pounds = 6.1 MMMcf.

Suffield - not calculated.

MEDICINE HAT - not calculated.

Tilley - not calculated.

These refer to developed gas pools in the ganeral over-all regions, local developments at these particular towns.

Q And who is Mr. Hume?

A Dr. Hume.

Q Dr. Hume?

A At the time he published this data he was director of the Geological Survey of Canada.

Q And do I understand that from time to time you make mention of his estimates of reserves?

A Yes, I use his estimates quite frequently in my report, because I found them to agree with my own estimates.

Q And you give credit to Dr. Hume where you do use them?

A Yes, at least, in most cases.

Q And that appears in the narrative itself?

A Yes.

Q Well, let us go on then now, unless there is something else you want to add?

A No, that is all.

Q To the Medicine Hat gas.

A The Medicine Hat gas field is one of the major fields

of the Province. The producing zone occurs in the upper oart of the Colorado shale formation. The sandy porous phase of the gaseous beds is about 15 feet thick. The porosity is probably quite high. The sand is very fine grained and there is an excessive amount of connate water, but no free water has been encountered.

Q What is connate water, Mr.Slipper?

A Connate water is the term applied to the water that is held to the sand grains by surface tension, by capillarity, and that water being held on the sand does not float freely through the sand. It is taken to the well eventually by the evaporation of the water, and as the gas moves through the sand it sometimes clogs up the sand around the gas well, and is contained within the bars just like the gas is.

Q It is held there by capilarry action?

A Yes.

Q What is free water?

A Free water is water that is not held that way. It is free to move through the sand. It is an excess over the water held by the surface tension. If the sand grains are large enough, and that is if the pore spaces are large enough, water may exist in that void in a free state, and is free to move.

Q Yes, all right, thank you.

A The Medicine Hat sand reservoir is not a structural type field, but originated as a sand bar in the closing period of the Colorado deposition of marine muds. There is no water drive.

Q Just explain that in a word, will you please, what is water drive?

A Sands that are coarse enough and that are associated with large depositions or large thicknesses extending to a higher level than that at which the gas occurs has a pressure, transmits a pressure because of it being above the gas to the gas, and in that way it is under a drive from the water, and we call such types of fields, fields with a water drive.

Q Does it supply the lifting power for the gas?

A It transmits its pressure to the gas.

Q To the gas?

A Yes.

Q And enables it to reach the surface?

A That is right.

Q And there is another kind of drive. There is a gas drive?

A That is a particular type, but this particular type is not a gas drive field. It is not connected with sand that extends somewhere with a water head in it to a higher level.

Q I see?

A Hume gives a pressure decline calculated reserve to the end of 1947 as 106.7 billion cubic feet to zero pound base pressure. The information is incomplete and systematic records were not maintained in former years. With this type of field a reliable reserve estimate can be made only when year by year records are maintained. The sand is so extensive and so thin, and the permeability is so low that the high production rate in the industrial areas of Medicine Hat and Redcliff had litt le effect on the reserves in the surrounding gas area. For instance, Well No. 80 six miles east of the town and drilled in 1947 had a closed pressure of 550 pounds, only ten pounds lower than the original closed pressure of 560 pounds measured some 40 years ago. Hume's figure of

106.7 billion is probably correct for the immediate area of production. The areal extent of the Medicine Hat sand is much greater than the producing area surrounding the city and neighboring Redcliff. The reservoir probably covers the area shown on Map No. 3.

Q Now, just let us look at 3. How is that area indicated on the map?

A By a rather heavy dashed line surrounding the black areas where the gas is developed. The reservoir probably covers the area shown on Map No. 3 which includes about 17 Townships or 612 sections. Accepting the estimate of 107 billion cubic feet remaining at an average pressure of 350 p.s.i.g. then the original volume at 560 p.s.i.g. was about 180 billion cubic feet. Assuming that this gas came from the producing area of about 90 sections, the gas per section approximates two billion cubic feet. For the 612 sections, the reserves would then be 1224 billion cubic feet. With a non-recoverable factor of one-third and subtracting a produced volume of 73 billion, I estimate the reserves of the Medicine Hat gas sand as about 743 billion cubic feet classifying it as a potential gas reserve.

Q And these figures that you are speaking about here are gathered together and are to be found in your summary at the end of your report on page 28?

A That is right.

Q Now, will you explain to the Board, if you will, this field?

A There are different types of gas fields in Alberta, and the Medicine Hat type is more or less characteristic of a sand bar type of field.

Q Now, you have made a drawing. It follows at page 6 in your report?

A Yes.

Q Perhaps you will explain to the Board what that drawing represents? It is entitled "Reservoir Classification Alberta, Medicine Hat type".

A Yes. This is a purely diagramatic representation, just to illustrate visually what I mean by a sand bar type of field.

Q What is the black patch?

A The black patch on it is the gas bearing sand. The vertical line is supposed to represent a well. The dashed lines surrounding the black lens represents shale. The dotted areas above and below try to represent sand.

Q Now, you say there are certain well known characteristics of this type of formation?

A Yes. This type has no water drive. The reason is that there is no connection with any water bearing sands, and it probably has a high connate water, a high percentage of connate water because of the very fine grain sand of which it is composed. It has probably low permeability also because of the fineness of the grains of sand. The sand is not particularly thick. It is a thin bar formed by shallowing of the sea out from the land, so that the porous parts of the body is quite thin. There might be local concentrations of free water, that is, in the irregularities of building up this sand bar there might be concentrations of coarse sand where free water could exist. Sometimes this is encountered in the drilling of the sand bar type of field, and you will have a local water bar, and some slow additions of gas from shale boundaries causing reserves to be higher than calculated, that is, the shale probably 200 feet thick above and below this particular bar will be gassy. This

gas will slowly enter the sand bar sand as gas is produced out of it.

Q It will take the place of the gas that is produced?

A Yes. And in this way there might be, depending on how rapid the gas is produced, there might be a higher reserve than any estimate of gas. For instance, if a person makes a reserve estimate on data for the sand bar, his reserves might be too low because gas is coming into the sand from the shale exterior about it.

Q Both above and below?

A Yes, that is right.

Q And then you have a note "Water logged"?

A The area around will become waterlogged from condensation of water, and this requires a high pressure at which abandonment will take place. That is, it requires a high pressure abandonment figure when you are estimating your reserves. You assume that your well is going to get water logged and start producing less and less until it is not economical to produce it any more, so that you try to get a figure at which that will take place when making your estimates, and for that type of field you would give it a high pressure.

Q A high base pressure abandonment, you call it?

A Yes.

Q Yes?

A And theoretically, the source of the gas is in the immediately surrounding shale.

Q Now, on Page 7, you have a short note on the Lloydminster Shallow gas.

Q DR. GOVIER: Mr.Slipper, before you go on, I wonder if you would elaborate on what you mean by potential

gas reserves? You have used that expression just at the end of the first paragraph?

A Yes. What I mean is that the data that I have for giving this estimate has low value, therefore I cannot give it anything more than a reserve estimate of low probability, and in expressing that idea I use the term of possible or potential.

Q You were using those two terms or expressions synonymously, were you, possible and potential?

A Yes, that is right.

Q MR.NOLAN: On the other hand, you used the expressions "proven" and "probable"?

A For different degrees of probability.

Q In other words, when you were coming to your conclusions at the end of your report, you have on the one hand "proven and probable"?

A That is right.

Q And on the other hand "potential and possible"?

A That is right.

Q And what is the difference between "probable" and "potential"?

A In my definition, as used in here, I consider a proven reserve to be one having very high probability because the data on which we made the estimate have some precision to them.

Q You have a basis for computation?

A That is right. And as this basis, in estimating other fields, as this basis becomes less accurate, or there are more unknown factors....

Q It becomes inadequate, shall we say?

A Yes, it becomes inadequate, and, consequently, I would say

that was a probable condition having the lower probability than the one where I had a great deal of information, and then going or grading down to the condition where I had to guess a lot, like in this Medicine Hat Reserve estimate, I say it is a possible reserve estimate.

Q I am anxious that the Board should know the basis upon which this witness has been proceeding to make his estimate. I hope that clears up the point that Dr. Govier asked the witness.

DR. GOVIER: There is still one uncertainty in my mind, Mr. Nolan. I notice you pointed out that the proven and the probable are added together in the summary?

MR.NOLAN: That is right.

DR. GOVIER: Yet you say that there is a different degree of certainty. That is what they really mean?

A That is right. On one page I have given a note. It is on Page 13.

Q MR.NOLAN: At the bottom of Page 13?

A I give a note here "Proven and Probable" gas reserves are defined as estimated with high probability. "Potential Reserves" are defined as reserves less well defined than "Proven and Probable".

Q And then you say "Where no estimate occurs"....

A Where no estimate occurs in potential volume it is intended to indicate that reserves exist but no numerical valuation is attempted.

DR. GOVIER: That is fine, thank you.

Q MR.NOLAN: Now, you had a short note on Page 7 on the Lloudminster Shallow Gas?

A Yes. In the Lloydminster area there is a persistent gas

sand at 1400 feet, which is quite extensive in Saskatchewan, but also underlies a portion of Alberta, as shown on Map No. 3. The amount of potential reserves is not estimated.

Q Why isn't it estimated?

A Because I haven't any data on which to do so, but yet I know that it is there, and it covers quite an area.

Q That is, there is no information available to you on which you could base a computation?

A There are some gas reserves, but I do not know how much there are.

Q Well, now, we come to what we call the Blackleaf Gas, and that is the Upper Cretaceous, is it?

A Yes, that is the Upper Cretaceous.

(Go to Page 69)

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BLACKLEAF GAS

The Blackleaf is a general name applied to a series of sands and sandy shales in the lower part of the Colorado. It includes in its widespread extent in Alberta, the Bow Island gas sand, the Foremost gas sand, the Viking gas sand and the Pelican sand, and it may include the Dunvegan sand of northwestern Alberta. Also included in the Blackleaf is the Basal Colorado sand developed in the Princess area. In other words, it contains most of the important gas accumulations of the Plains region of Alberta. There are also some small oil occurrences within it; such as the Joseph Lake oil field and some oil and naphtha in the Princess area. Most of the developed gas fields are of the stratigraphic trap type. There are some structural types of reservoir of small size near the Montana boundary as well as compaction type of structures northward.

The discovered gas fields and the individual gas wells of the Blackleaf are listed below. Localities are shown on Map No. 3. The northern truncation of the Blackleaf strata is also shown on Map No. 3.

Q Now, just look at No. 3 for a moment, if we may. You indicate on this map where gas fields are to be found in this particular strata?

A Yes.

Q Well then, would you just read those to me if you will so I can follow on the map where they are, the gas fields of the Blackleaf.

A 1, Smith Coulee.

Q Where is that?

A That is down in the southern part of the Province in about

Township 3, Range 10, West of the 4th Meridian.

Q It is south of Foremost, is it?

A It is south of Foremost, yes.

Q What is there there?

A There is one gas well and it is in the Bow Island sand.

Q And the second?

A The second is the Pendant d'Oreille field and there are eight wells.

Q And they/are in the lower right hand corner of your Map No. 3?

A Yes. That is that long black block.

Q Then Foremost?

A Then Foremost field, five wells in the Bow Island sand. These are all down in that area. 4, Manyberries Field, three wells in the Bow Island sand.

Q It is marked with a black mark?

A Yes. 5, Eagle Butte, one well, Bow Island sand, abandoned.

Q Where is Eagle Butte?

A It is marked there, Eagle Butte No. 1, Township 7, Range 4.

Q You say that well is abandoned at Eagle Butte?

A Yes.

Q Why was that, do you know?

A Because, as I mentioned farther on, it rapidly blew out to water. 6, Bow Island Field. It is now under repressuring from the Turner Valley gas. 7, Princess Field. This is jumping north.

Q It is a little northwest of Medicine Hat, isn't it?

A That is right. It is Basal Colorado sand, seven wells. 8, Hudson's Bay Sparky, one well, Bow Island sand. 9, South Brazeau No.4, Bow Island sand.

Q And they both show on your map?

A Yes. As a matter of fact, the reading of the gas fields of the Blackleaf is not exactly correct because some of these mentioned are not fields but are individual gas wells.

Q And that is true of this one we are talking about?

A Yes.

Q All right.

A 10, Provost Field. I have not put down the number of wells. Viking sand.

Q And it shows near the Provincial boundary?

A Yes, it is shown there in black. 11, General Pete No. 1, one well, Viking sand. It is shown just southeast of the Viking field, the southeast corner of the Viking field. 12, Jarrow No. 1, one well in the Viking sand.

Q Immediately south of the Viking?

A Yes. Then there is the Viking Field, Viking sand, 69 wells. 14, Texaco Superior Ranfurly, one well, Viking sand.

Q Just north of the Viking Field?

A Yes. 15, Elk Point, one well in the Viking sand. Elk Point is north and east of the Viking sand in Township 56.

Q Yes?

A Imperial Leduc, one well, Viking sand, in the Leduc Field.

Q Yes?

A Cardiff Giant, one well in the Viking sand. That is north of Edmonton.

Q It is a little north and east of Edmonton, is it?

A Yes.

Q No, a little west.

A North and a little west. Imperial Excelsior, one well, in the Viking sand. Imperial Bon Accord, two wells in the

Viking sand. Bon Accord, I do not know whether you can see it or not. Imperial Legal, two wells in the Viking sand. That is shown.

Q That is north of Edmonton?

A Just north of Edmonton too. Imperial Lily, one well in the Viking sand. Union Picardville, one well in the Viking sand. 23, Redwater Oil Field, nine wells in the Viking sand.

Q And they are indicated?

A By a dash and an arrow, yes. 24, Central Lac la Biche, one well in the Pelican sand. 25, Stanolind Lac la Biche, one well in the Pelican sand.

Q You go on from this point and you take these wells and fields and discuss them in detail?

A Yes.

Q The first of them being the Smith Coulee?

A Yes. SMITH COULEE (1) There is one well in the Smith Coulee Field. Gas occurs in the Bow Island sand at a depth of 1,836 feet. The sand appears to be about four feet thick. The well has an open flow of 6,900 Mcf. and a bottom hole pressure of 573 pounds. Three other wells have been drilled dry with only a northwest direction now open for extension. The well is probably in an up-dip pinch-out of the Foremost type. The possible gas reserves are indeterminate.

Just ahead of page 8 is a sketch explaining what I have just said about being on a pinch-out type of field.

Q Well, that just follows page 8, doesn't it?

A That is right, it follows page 8.

Q Perhaps we could look at that now because I want the Board to

know what you mean by a up-dip pinch-out. I take it those black patches are the sands that contain the gases?

A They represent portions of the sand that have the gas accumulation in it.

Q And I suppose it is up-dip because the formation rises?

A Yes. Gas is lighter than water.

Q What is the pinch-out about it?

A That shows the cross-section of a sand that is gradually tapering out into shale. Such a type of sand field is called a pinch-out type.

Q Now, what are the characteristics of this particular reservoir?

A It is a water drive. That is, there is water pressure behind the gas, high permeability because some of the sands in the area are very coarse, and the pressure adjustment is continuous because of encroaching water, that is, as the gas is taken out the water follows the gas up into the portion that did contain gas. Reserve calculations by pressure decline are uncertain because the reservoir is not fixed, it is moveable, it is shrinking as the gas is taken out, consequently you can take fixed figures but they are not very accurate. This low connate water, the sand is probably so porous that their connate water percentage is low.

Q And free water percentage is high?

A Well, it will be as the gas is taken out, the free water comes right into the sand. And their low base pressure to abandonment, that is,your well can probably be produced down to when the water comes in. The pressure will not drop very continuously.

Q So you might get 100% recovery?

A That is right.

Q You say the possible gas reserves are indeterminate. Just what do you mean by that?

A I have only one dimension. You can not measure a volume with one dimension, you have to have three.

Q In other words, you have not got the basis for calculation?

A That is right.

Q Well now, that deals with Smith Coulee. You have dealt with Pendent d'Oreille, Foremost and Manyberries under one head?

A Yes.

Q Will you please go on.

A PENDANT d'OREILLE (2) FOREMOST (3) MANYBERRIES (4). All three of these fields are of the same type. The gas is accumulated in the up-dip edges of a sand pinch-out. In the Foremost field there is one sand wedge pay, in Manyberries there are two, while at Pendant d'Oreille there are three pays.

Hume has carefully estimated the gas reserves of the three fields, and I am accepting his reserve figures. Since these fields have high permeability and are under water drive, it is expected, with good production practice, that the fields may be produced down to 100 pounds base pressure. Therefore, the proven reserves of the three fields are:

Pendant d'Oreille	-	270 MMMcf. (Hume)
Manyberries	-	31 MMMcf. (Hume)
		301 MMMcf.
Foremost	-	13 MMMcf. (Slipper)
TOTAL	-	314 MMMcf.

Q And these figures will be reflected again?

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A They are recapitulated.

EAGLE BUTTE (5) The Eagle Butte well is an abandoned well which is included here only to show what caution should be used in estimating the reserves from a single wildcat gas well. Eagle Butte No. 1 blew in with several million cubic feet open flow. It was allowed to blow freely for a day or two with the result that the gas was followed with a spectacular flow of water. The conclusion is that the well indicated only a few million cubic feet of gas in a restricted pinch-out. The area of the gas field apparently was only a few acres. If the well had been immediately closed in on discovery, some estimating methods used would have assumed an erroneous reserve of some three square miles.

Q I was just going to ask you about Eagle Butte. If it had been closed in you say that it might have given an erroneous impression?

A Yes.

Q But all gas that was down there came up?

A Yes.

Q You say this open flow lasted for a day or two?

A That is right.

Q Now, Bow Island is No. 6.

A BOW ISLAND FIELD (6) The Bow Island gas was the first Blackleaf discovery. Its history has been given in several publications. It is now a repressured reservoir using gas from Turner Valley. The gas stored amounts to about 14 billion cubic feet.

It is quite likely that there are several similar but undiscovered stratigraphic traps on the east flank of the Sweetgrass Arch.

Q Bow Island field is the first Blackleaf discovery but it is not the first gas discovery in this Province, is it?

A Oh, no.

Q Do you know where the first gas discovery was?

A The first gas discovered and used was at a place called Alderson.

Q That is right. Do you know the year?

A The Canadian Pacific main line, oh, just up on a hill there from Medicine Hat.

Q It was on their right-of-way?

A Yes.

Q Do you know what year that was?

A I think it was 1905. I am not sure about that.

Q However, these wells you are talking about now --

A That, of course, was from the Milk River zone, the zone on Figure 2.

Q The Medicine Hat field itself is an older field than the Bow Island?

A Oh yes, it is older.

Q Was it Coste discovered the Bow Island field?

A Yes, Eugene Coste. When I said 1905, 1895, somewhere around there.

Q It was before the turn of the century, wasn't it?

A Yes. It is recorded somewhere, I can't remember where.

Q You have just mentioned Bow Island as being a storage plant for gas?

A That is right.

Q Now, Princess Field.

A <u>PRINCESS FIELD (7).</u> There have been no commercial flows of

Foremost gas discovered in the Princess Field. However, a sand, the Basal Colorado, which contains gas in several Princess wells may be properly included in the Blackleaf series of beds.

Q Basal Colorado is a sand formation?

A That is right. The Bow Island sand lies about 200 feet or so, maybe more in places, above the Lower Cretaceous. The Lower Cretaceous lies immediately underneath the Colorado. The Colorado is the name given to the group of shales in which the Blackleaf is the sandy lower part. Now, the Basal Colorado sand is described here. It lies immediately on top of the Lower Cretaceous, and it would be lower down than the Bow Island gas sand in the section.

Q Then in this Princess field there are certain wells?

A Yes.

Q You set them out, do you?

A I set them out in a column here. Anglo-Canadian-Steveville sea level elevation, -436 feet sub-sea.

Q That means below sea level?

A Below sea level.

Q Is that the depth?

A No, that is the altitude of the top of the sand.

Q From the surface of the earth to the top of this sand formation. The distance between sea level and the top of the sand formation?

A Yes.

Q And what is the Mcf. flow?

A That is the open flow expressed in thousands of cubic feet.

Q Per day?

A Per day.

	Sand Elevation	Mcf. Flow	Pressure
Anglo-Canadian-Steveville #1	-436	6,460	-
Anglo-Canadian-Steveville #2	-351	1,480	-
Princess Steveville No.2,	-357	8,000	-
Anglo-Canadian-Rainy Hills #1	-330	5,210	1,050 psig.
Toronto Syndicate,	-494	1,500	-
Princess C.P.R. 76-33-A	-383	700	-
Princess C.P.R. 64-8-19-11	-332	3,375	-

Q 1,050 psig?

A Pounds per square inch.

The type of structure (that is the type of structure that affects this Basal Colorado sand) is uncertain except that it is some kind of a stratigraphic trap. The extent of the field is also quite unknown, and, therefore, the reserves cannot be estimated. Most of the wells showed some water with the gas suggesting that edge water is nearby. Hume discusses the gas reserves of the Basal Colorado in the Princess area in some detail. He submitted a reserve figure of 93.2 MMMcf. Accepting this figure as a minimum amount of gas reserves in the Basal sand, it is my opinion that there is considerable promise for this pay zone to be developed into a major gas field.

Q And do you accept Dr. Hume's figure?

A Yes, as a minimum figure.

Q Now, there is this Hudson's Bay Sparky Well, that is a single well?

A Yes. HUDSON'S BAY SPARKY WELL (8) North of the Princess field a Viking sand gas flow has recently been discovered in

the Hudson's Bay Sparky Well. My information is that a total gas flow of over five million cubic feet in the Viking sand at a depth of 2,585 feet in 27 feet of pay was encountered. No. 2 Well drilled a few miles southeast did not obtain any gas in the Viking sand. Being a one well discovery no reserve estimates are permissible. However, the region north of this well in my opinion, offers considerable promise for important Viking gas sand development.

Q Now, you make a statement there, Mr. Slipper, "My information is that a total gas flow of over five million cubic feet in the Viking sand at a depth of 2,585 feet in 27 feet of pay was encountered." Where do you get this information?

A From the Conservation Board nearly always.

Q Because records were kept there compiled from information supplied by the producers?

A That is right.

MR. D.P. McDONALD: Is it hearsay, Mr. Nolan?

MR. SMITH: This from you is good.

Q MR. NOLAN: Then there is the South Brazeau.

A SOUTH BRAZEAU NO. 4 (9) The South Brazeau No. 4 Well obtained a moderate flow of gas in a Viking sand drill stem test at a depth of 3,258 feet. The flow was measured at 2,043 Mcf. Other wells drilled in the same Hanna area did not obtain any gas flow of importance in the Viking sand. Since this is a one well discovery, no reserve estimate is permissible.

Q Well, now, the Provost Field?

A THE PROVOST FIELD (10) The Provost Field is a typlical Viking sand gas field. It is supposed to be outlined by dry holes.

The Imperial Oil Company's estimate of 100 MMMcf. is accepted. The area of the field is about 40 square miles. There is some possibility that the field has a greater linear extent than has been assumed. If so, it may contain a greater reserve than calculated. It is my opinion that the field does contain greater reserves than presently estimated.

Q Where did Imperial make that estimate?

A I think it was at the Dinning Commission but in any case it was hearsay information that I got over the telephone from Mr. Cotter of the Imperial Oil Company.

Q Of their engineering department?

A Yes.

Q Then at the top of page 11?

A There are a few Viking sand wells in the neighbourhood of the Viking-Kinsella field, but outside its boundaries; such as General Petroleums Limited No. 1 (11) Jarrow (12) and Texaco Superior Ranfurly (14). These gas occurrences are in small patches of clean Viking sand in which minor accumulations of gas have collected. There is a larger number of dry holes and producers in the same general relationship to the Viking field. I am of the opinion that these occurrences are of small reserve value.

Q Well, now, your next heading is the Viking-Kinsella Gas Field.

Q MR. SMITH: Before you go on, Mr. Slipper. You said there is a large number. Is that the way it should be?

A There are a larger number of dry holes than there are producers. I mentioned the three producers before but there

are more than three dry holes in the area.

Q MR. STEER: The word "an" should be "than"?

A Yes, it should be.

Q MR. NOLAN: The Viking-Kinsella, you have a map No. 9 in the report.

(Go to page 82)

Q Is there anything you want to say about map No. 9?

A This shows the Viking gas producers and some of the surrounding wells.

Q I think you said there were 68 wells in that area?

A Yes. In this morning's paper two wells were reported as being drilled, completed, in Township 49, Range 9, within the last day or two. One of these is in - -

Q That would be near Imperial Kinsella No. 2?

A Yes, near Imperial Kinsella No. 2. One is in I think it is 16. One is in section 16, the middle of the section, and the other one is in section 23.

Q This map does not require any explanation?

A No.

Q It shows there. What have you to say about this field?

A The Viking-Kinsella gas field. The Viking-Kinsella Field is an excellent example of the off-shore sandbar type of reservoir.

Q Would you just explain that to me, "offshore sandbar type"?

A Yes. It is a sandbar that is more or less some distance from the shore, that is, quite a way offshore. It was quite a way offshore when it was deposited in those times, in that time. It is more separated from the sands of the beach to the southwest of the present locality of the Viking.

Q Yes?

A This sandbar therefore is an isolated body of sand. It is separated by sandy shale from the main body of the Blackleaf to the southwest.

Q It is something like an island of sand?

A Something like an offshore bar in the ocean.

Q You have attempted to give us a diagram of it on the next

page, haven't you?

A Yes. Now the reason for that sandbar forming there - this is the theory of it - the reason for the sandbar forming there is that there was a shallow reef in the ocean bottom at the time that these sediments were being brought in from the west. This reef caused a formation of sandy bars just above it, due to the slowing down of the ocean currents and in this way the bar that we call the Viking Field was formed over a limestone hill which lies immediately below it.

Q And this you have attempted to show in the diagram?

A This I have attempted to show in the diagram. The reason why in these first gas formations lying below the sandbar are much thinner than they are to the right or left is shown in this diagram.

Q What are the characteristics of this reservoir?

A There is high permeability along thin belts. That is probably due to the fact that there are bands in the sandbar of coarser texture than in other parts of the sandbar. Consequently there are belts of high permeability. There is no water drive because it is not connected with any sands giving out water pressure. It has high connate water which is increasing at the boundaries. The sand also gets finer towards the left and right of this diagram and it will contain a greater percentage of connate water than say in the middle part of the bar. It is a coarser grained sand. The sands are fine grained with coarser grained lenses where free water may occur. That is, the sand may become more coarse in places and that there will be free water encountered in some of the wells. That happened, I think, in well No. 28 recently. They drilled a well that was a gas well for a

little while and then it became a water well. It is pretty well within the boundaries of the gas field, so that patches of sand containing free water will be encountered. The gas source is within the sand and in overlying and adjacent shale. It is much like the Medicine Hat type of gas sand. The probable origin of the gas is in the shales above and below. In the case of the Viking sand there are shales intermixed with the sand which probably also acted as a source for the gas. The wells become waterlogged by condensation around the well at high base pressure.

Q For the same reasons you have mentioned with respect to Medicine Hat?

A Yes, for the same reason I mentioned before. Oil shows are common in the sand.

Q So much for the figure and now for the narrative.

A <u>The Viking-Kinsella Gas Field</u>.

The Viking-Kinsella Field is an excellent example of the off-shore sandbar type of reservoir. The sand is fine grained, has a high porosity and a high connate water. There is no water drive though there is considerable free water outside the boundaries of the field. In the gas area the water is held to the sand grains by surface tension while the gas is permitted to flow freely. However, in small patches where the sand grains become coarser than the average in the field, free water will be produced with the gas.

The permeability is quite variable, usually the high gas flow rates are obtained from the middle two or three feet of the average 8 feet of section of pay.

My estimate of proven reserves is some 700 billion cubic feet down to 200 pounds base pressure.

Q What does that mean, "down to 200 pounds base pressure"?

A Down to an abandonment pressure of 200 pounds. I am presuming that these wells will become uneconomic at 200 pounds pressure.

Q That is because there is so much - -

A That is because they become waterlogged and dirty.

Q So much for Viking-Kinsella. The Elk Point Gas Field. There is one well there?

A ELK POINT GAS FIELD

In the Elk Point Field one gas well obtains gas from a thin porous streak in the Viking horizon. It is of no importance in the reserve estimate, and other drilling in the area indicated that the Viking as a gas sand has no areal extent of any significance.

VIKING SAND GAS IN THE LEDUC OIL FIELD

In the Leduc Oil Field the conditions are more or less favorable for the occurrence of a Viking sand gas accumulation. However, only a few positive drill stem tests are recorded. Some of these are as follows:

	Depth	Flow
Imperial Leduc 3	3447 - 3500	4,000 Mcf. per day
Imperial Leduc 10	3447 - 3467	4,000 Mcf. " "
Imperial Leduc 80	3409 - 3416	1,565 Mcf. " "
Imperial Leduc 136	3236 - 3249	4,000 Mcf. " "
Central Coop.Pyrcz No. 5C.	3392 - 3421	2,000 Mcf. " "

Q And that is open flow cubic feet per day, is it not?

A Yes. There were a number of negative or very light flow tests. These suggest that there is no continuous Viking gas reservoir of appreciable dimensions. The successful tests are concentrated on the northeast margin of the field.

VIKING SAND GAS IN THE MORINVILLE AREA

There are several scattered wells which obtained Viking gas flows in the Morinville area. These are Cardiff-Giant (17), Imperial Excelsior No. 1 (18), Imperial Bon Accord -

2 wells (19) Imperial Legal - 2 wells (20) Imperial Lily (21) Union Picardville (22). There have been some more recent Viking gas discoveries that are not included here. It is possible to include these wells in an area of supposed Viking production of about 120 sections, and if it is assumed that there are about two billion cubic feet per section, then there may be some 240 billion cubic feet of gas reserves. This figure is offered but cannot be defended since there are no data presenting proof of continuity of a gas reservoir over the area.

Q You say the figure is offered but cannot be defended. Is it carried into your summary?

A It is carried into my summary, yes.

Q Now we have got some Viking sand in the Redwater area?

A Yes.

VIKING SAND GAS IN THE REDWATER OIL FIELD

The geological conditions in the Redwater Oil Field are favorable to the occurrence of commercial Viking sand gas fields.

Commercial flows of gas have been discovered in drill stem tests in the Redwater field. There are also three Viking sand operating gas wells in the field. These are:

Imperial Redwater 11 - 2,000 Mcf. - 750 P.s.i.g.

Imperial Redwater 71 - 3,500 Mcf.

Royalite Redwater 17-15 - 950 Mcf. plus.

In the successful Viking sand drill stem tests, the following may be mentioned.

	Flow	Depth
Gulf-Shkolny #1	2,580 Mcf.	2130-35
Gulf-Shkolny #2	3,000 Mcf.	2139-57
Gulf-Bigoray 16	2,130 Mcf.	2053-2125

	Flow	Depth
Royalite Redwater 4-15	2,200 Mcf.	2005-2101
Royalite Redwater 3-15	1,110 Mcf.	1964-2077
Royalite Redwater 11-15	450 Mcf.	2014-2015
Imperial Redwater 1	1,225 Mcf.	Depth not given.
Imperial Egremont 20	1,100 Mcf.	1931-1959
Imperial Simmons 1	1,177 Mcf.	2038-2081
Western Redwater 17-14	1,800 Mcf.	2104-2124
Imperial Redwater 48	12,199 Mcf. (In three zones)	2033-2060 2088-2105 2136-2156

Q DR. GOVIER: Is that figure the total of the tests in each of the three zones?

A Yes. In addition there are some nine or ten Viking drill stem tests, which showed comparatively light flows from 120 Mcf. to 700 Mcf. per day. Drill stem tests do not necessarily indicate the capacity of the well. In general, those with high drill stem tests frequently result in large capacity wells on production.

(Go to page 88.)

The wells listed are scattered over the oil field, but some of the better wells are in groups. Probably most of the Redwater oil wells were not tested at the Viking sand. But because of the number of light drill stem tests at several wells it is not safe to assume a blanket gas reservoir over the whole field. It seems more probable that there are a number of gas pools. Assuming that 15 sections of the 30 or more sections in the field are gas bearing to the extent of one billion cubic feet per section, then a possible reserve of 15 billion cubic feet is suggested. That figure is also carried over into my potential.

LAC LA BICHE AREA (24) (25)

North and east of Lac la Biche two Viking sand gas discoveries were made. These are Stanolimd Lac la Biche No. 1 and Central Lac la Biche No. 1. There appears to be no information on the flow of Stanolind No. 1, but it was reported as a large gasser. Central Lac la Biche had a measured flow of 4,250 Mcf. at 758 feet. The pressure was 350 p.s.i.g. These two locations are seven miles apart. There is no other information on which to base reserve estimates though there appears to be a promising gas area adjacent to the wells.

Q And so you make no estimate?

A That is right.

Q Now, we have got a Table, Number 2, and that recapitulates everything that you are able to estimate in the Blackleaf formation?

A That is right.

Q Perhaps you will just read that Table?

TABLE II - SUMMARY GAS RESERVES IN BLACKLEAF

Field	Proven & Probable	Potential
Smith Coulee	No estimate of any sort	-
Pendant-d'-Oreille	270(Hume) 100 p.s.i.g.	
Manyberries	31(Hume) 100 p.s.i.g.	
Foremost	13(Slipper) 100 p.s.i.g.	
	These are the base pressures, the 100 pounds.	
Bow Island(repressured)	14 (C.W.N.G.Co.)	
Princess(Basal Colo.)	93.2 (Hume)	Larger reserve suggested.
Hudson's Bay Sparky		No estimate
South Brazeau 4		No estimate
Provist Field	100 (Imperial)	
Viking Kinsella	700 (Slipper)200 p.s.i.g.	
Morinville Area		240 (Slipper)
Redwater (Viking)		15 (Slipper)
Lac la Biche		No estimate
Total Alberta Blackleaf	1221.2 MMMcf.	255 MMMcf. plus

Q And those figures are carried forward into your grand total of 12 trillion plus?

A That is right.

Q Now, you have already given us the note?

A Yes, I have referred to the note.

Q And we come now to another formation. We have dealt with the Blackleaf, which was the Upper Cretaceous, and now we turn to the Lower Cretaceous?

A Yes.

GAS RESERVES OF LOWER CRETACEOUS SERIES

The Lower Cretaceous (Map No. 4)....

Q8 Now, is there something on that map to which the attention of the Board should be drawn, No. 4?

A Yes, No. 4. The locations mentioned in the text are shown on this map.

Q Yes?

A And the information contained therein is also given in the text.

Q And you deal with this series, the wells and fields, in precisely the same way as you did in the Blackleaf?

A Yes, as I have done before.

Q With a note under each?

A Yes, that is right.

Q Perhaps we could go on then with the narrative?

A The Lower Cretaceous includes a thick but variable (200 to over 800 feet) collection of sandstone, shale and coal seams. There is considerable variety in the rock types. Some of the strata are marine though the greater part of the series is brackish or fresh water deposits, in central and southern Alberta. North of Edmonton marine beds are prominent.

Commercial gas flows have been discovered in the top beds of the series but there are very few gas wells. Gas occurs also in the middle of the series, but is relatively unimportant. The main gas pays are encountered in the sands in the lowest part of the formation. These sands are frequently referred to as the Basal Lower Cretaceous sands. In southern areas the Basal sand is known as the Sunburst, Princess and the Taber sand. In northern Alberta the Basal Lower Cretaceous is called the MacMurray sand in one of its developments.

A remarkable fact about the Lower Cretaceous occurrences is that there have been of late years more wildcat discoveries in this series than in any other stratigraphic division of

the Alberta section. In spite of this there have been no major gas fields developed in the Lower Cretaceous either in the past or recently. One explanation given for this is that no follow-up drilling has been done. This is quite true, but experience in exploring for gas fields in the Lower Cretaceous places the real cause in the nature of the Lower Cretaceous reservoirs, which typically are restricted thick lenses or wedges of sandstone. The sands are generally coarse and very permeable giving in places extremely large rates of flow. Most of these sand bodies originate on the surface of the Mesozoic-Paleozoic unconfirmity which is an aquafer (that is an under-ground water carrier). On this account water gas interfaces are found at anomalous elevations. While it is admitted that there are no proven large gas fields in the Lower Cretaceous, it is possible that such will be discovered as exceptions to the generality that the reservoirs are of restricted size.

It is significant that with the one exception of the Taber pay, Basal Lower Cretaceous contains gas only where it is in contact with the Paleozoic (that is with beds of Group 3). Where the Ellis or Fernie shale intervenes there is little or no gas accumulation. This appears to indicate that the Basal Lower Cretaceous gas had its source as a seepage from the underlying Devonian and Mississippian beds.

In view of the nature of the Lower Cretaceous reservoirs, it is advisable to be cautious in estimating reserves on a one well discovery. While experience has shown most of these to be indicative of small accumulations nevertheless there is always the possibility that an extensive sand reser-

voir has been tapped. The flow rate capacity of a well does not determine the size of the reservoir, which is determined only by step-out drilling.

The following are the known reserves or significant discoveries of gas in the Lower Cretaceous:

TABER GAS RESERVES

Five wells in the Taber Field report appreciable flows of gas from the Taber sand.

	Flow
Major Taber 1	7,000 Mcf.
Major Taber 3	No information
Taber Province 72-15A	1,007 Mcf.
Mid-Continent Universal	2,200 Mcf.(Drill Stem test)

There are no data on which to estimate reserves in the Lower Cretaceous in the Taber Field.

TILLEY AREA

Gas was encountered in the Lower Cretaceous in two of the Northwest Company's wells which were drilled for oil exploration into deeper beds. Six other wells were drilled in the vicinity without showing commercial flow. Hence the gas in this area is not considered as reserve.

These two fields are shown on the map Figure 4, and south of the South Saskatchewan River.

Q Tilley and Taber?

A Yes.

BANTRY AREA

There is one gas well in the Bantry Area, the California Imperial Bantry 11-2-18-13 which reports on a drill stem test 2,500 Mcf. While this one well does not supply adequate data for an estimate of reserves the occurrence

of commercial gas is interesting.

Q Where is Bantry?

A The well is not shown on here. It is south of Princess.

Q Yes? It is shown on the map "Cal. Imp. Bantry".

A Oh, yes.

THE PRINCESS GAS FIELD

The Princess Field is probably the most important Lower Cretaceous gas field in the Province at the present time. The following gas wells are significant:

	Depth	Flow	Pressure
National Empire No. 1	3,283'	8,146 Mcf Open flow	1,340 p.s.i.g.
Patricia C.P.R.#1	3,308'	3,500 Mcf. (D.S.T.)	1,600 p.s.i.g.
Peerless Oil No.1	3,173'	1,500 Mcf. (D.S.T.)	-
Princess Brooks Syndicate #1	3,278'	3,500 Mcf. (D.S.T.)	-
Princess C.P.R. No. 1	3,161'	10,000 Mcf. (D.S.T.)	-
Princess C.P.R. No. 3	3,149'	9,000 Mcf. (D.S.T.)	1,490 p.s.i.g.
Princess C.P.R. No. 4	3,173'	16,000 Mcf. (D.S.T.)	-
Princess C.P.R. No. 5	3,157'	5,000 Mcf. (D.S.T.)	-
Princess C.P.R. No. 6	3,160'	10,370 Mcf. (D.S.T.)	-
Princess C.P.R. No. 7	3,192'	5,000 Mcf. + (D.S.T.) with water condition uncertain	-
Standard McDougall-Segur	3,265'	7,880 Mcf. (D.S.T.)	

Note the high volumes on drill stem tests and the high gauge pressure of about 1500 p.s.i.g. Hume's reserves to 100 p.s.i.a. for the Princess and Patricia area of 230 MMMcf. is considered satisfactory.

The reservoir is probably a lenticular sand body lying against a Madison limestone escarpment. While there is evidence

of a structural reversal at Princess, stratigraphic conditions controlled the accumulation of the Lower Cretaceous gas.

Q There is a difference in what you used there. You used pounds per square inch and Dr. Hume was using pounds per aquare inch absolute?

A Yes. He is using a pressure, he gave the pressure at the sand, that is, the gauge pressure plus pressure of the column of the gas, plus the atmospheric pressure.

Q Well, it is a recognized method?

A Yes, it is recognized.

Q And what is "a lenticular sand body"?

A Lens like sand body.

Q All right. Now, the Jenner well is next?

A Yes.

JENNER WELL

Gas was found in the Sunburst sand at 3,097 feet and after casing and perforating, flowed at the rate of 2,500 Mcf. at the Jenner well. After 15 hours the flow declined to 185 Mcf. T he well has been abandoned. It has no reserve significance.

HANNA GAS FIELD

There are two Lower Cretaceous gas wells in the Hanna Field -

	Depth	Flow	Pressure
Dowling No. 1	3,816	20,000 Mcf.	1,200 p.s.i.g.
South Brazeau No.4	3,742	5,000 Mcf.	-

These wells are about 10 miles apart and are considered single well discoveries and do not afford a sound basis for a reserve estimate.

STETTLER AREA

Extending westward from the Provost Field to Range 24, West of the Fourth Meridian in Townships 37 and 38 are five widely spaced Lower Cretaceous gas wells. These wells are located along an extensive system of escarpments in the Madison limestone underlying the Basal Lower Cretaceous. Such topographic forms on the Paleozoic surface are conducive to the formation of Basal sand stratigraphic traps and compaction folds favorable to the accumulation of gas. The region which contains these wells may produce extensive reserves. At present, however, the wells are to be classed as individual discoveries without adequate estimating value.

	Depth	Flow	Pressure
Provost No. 2	2,631	1,500 Mcf.	-
Sun Coronation Province			
Bailey Castor	3,486	35,000 Mcf.(DST) estimated	
Picadilly Interleduc No.1	4,336	11,000 (DST)	1,200 p.s.i.g.
Louis Warren No. 1	5,008	1,570 Mcf.(DST)	

These wells are shown in a line across Townships 37 and 38, East of Red Deer.

Q On Map No. 4?

A On Map No. 4.

There are, however, several dry holes in the Lower Cretaceous in the vicinity of Picadilly Interleduc No. 1.

Q Tell me, has there been any discovery in the Stettler area since you wrote this report?

A Oh, I think there must have been.

Q Didn't the Gulf people make an announcement last week?

A I am not sure about that, but I think there have been some other wells there. I am not sure about it.

Q My information is that there was a very large producer announced by the Gulf Company in this area which we are now discussing?

A I have not the information.

MR. C. E. SMITH: Did you say announced by the Gulf Company or found out by somebody?

MR.NOLAN: I understood there was an announcement. Certainly something appeared in a New York paper about it.

MR. C. E. SMITH: O.K. I hope we hear about it too.

Q MR. NOLAN: Well, then, Martin No. 1, where is that?

A That is an isolated gas well south of Wainwright. It is shown in Township 42, about Range 8.

Q Just due south of Wainwright?

A Yes.

Q And what do you say about that?

A This is an isolated well which is reported to have had 1,000 Mcf. in the top of the Lower Cretaceous. No other information is available.

WAINWRIGHT

A number of wells were drilled during an active oil exploration in the Wainwright and Dina areas. A few of these showed very large flows of gas in the upper and lower part of the Lower Cretaceous, but surrounding wells in all cases showed the gas to be in quite small accumulations. I am of the opinion that both these areas may be ignored in reserve estimates.

VERMILION AND LLOYDMINSTER FIELDS

North of Wainwright in the Vermilion area a Lower Cretaceous gas has been developed as a supply for the small town of Vermilion. There was also considerable oil exploration

in the area which added to the number of wells drilled.

At one time it was believed that a large gas field occurred in this area. However, after unsatisfactory supply conditions for a few years, it is now realized that the reserves are very much less than earlier estimates indicated. I estimate them at 2 billion cubic feet. Development will add sufficient gas reserves for the local area.

At Lloydminster gas has been produced for the town from several Lower Cretaceous wells in Saskatchewan and in Alberta. I estimate the reserves at about 5 billion cubic feet in Alberta.

Q And then you are taking the Edmonton area as your next heading?

A That is my next heading, Edmonton and North.

Map No. 4 shows there is a greater concentration of Lower Cretaceous gas wells in the region of Alberta around Edmonton and northward than elsewhere in the Province. This is due in part to the greater concentration of drilling. The ratio of dry holes to gas discoveries in the Lower Cretaceous is about 5 to 1. However, there is also a tendency toward greater continuity of the Basal Lower Cretaceous reservoir bodies. In my opinion, there is reason for an optimistic outlook in respect to reserves of Lower Cretaceous gas as far north as Township 80.

Q Where is that on Map 4?

A Township 80 goes up to north of House River, or just about House River on the Athabasca. Not quite that far.

Q Just up in the vicinity of north of Imperial Normandville 1?

A Yes.

Q Yes.

A I have, on previous occasions, made reserve estimates in this region with little more information than the fact that

there is a considerable thickness of very gaseous beds in the marine sand and shale alternations of the northern Lower Cretaceous section. In order to obtain an estimate with a numerical value, I used as a guess, a saturation of 50 million cubic feet per sectionaand obtained an overall gas saturation of about 5 trillion cubic feet. With the additional information that the dry hole gas well ratio appears to be around 5 to 1, I am assuming that success in the finding of accumulation in the region will be of about the same order, and therefore, the possible reserves may be about 1,000 MMMcf. It is recognized that this type of guessing should be classified with a low degree of probability. With the wide spacing of wells that prevails, it is as yet unsafe to assume extensive continuity of reservoir or reservoirs in this region.

It should be noted that over the far north part of this gas region the closed pressures are very low, in the neighborhood of 300 p.s.i.g. The terrain is difficult and it is doubtful that gas development will be feasible in the near future over the greater part of the region.

I am going back. There is a mistake here in this township 80. That should be Township 108.

Q It goes up to 109?

A I took it up to the truncations.

MR.STEER: That is 108?

A Yes, 108 instead of 80.

Q MR.NOLAN: The MacMurray truncation touches 108?

A That is on page 17?

Q MR. C. E. SMITH: Your map shows that anyway?

A Yes.

MR. STEER: 108?

A Yes.

MR.NOLAN: Yes, 108 instead of 80.

(Go topage 100)

S. E. Slipper - Dir. Ex.

A LOWER CRETACEOUS IN THE POUCE COUPE AREA.

Some gas has been proven in the Pouce Coupe area of Alberta in the Lower Cretaceous. Three wells in the Gates Sandstone have proven a gas reserve of about 100 billion cubic feet.

LOWER CRETACEOUS IN THE REDWATER OIL FIELD.

There were two or three drill stem tests showing Basal Lower Cretaceous gas in the Redwater wells, but there does not appear to be any appreciable reserve within this zone of the oil field.

LOWER CRETACEOUS GAS IN THE LEDUC OIL FIELD.

Gas was obtained at the following wells and drill stem tests of the zone during the drilling of oil wells.

THE CHAIRMAN: I think we might take those as read unless there is some particular information you wish to emphasize.

Q MR. NOLAN: Is there anything in that Table you would like to draw to the attention of the Board?

A THE WITNESS: Nothing except what is in the following text.

Q Yes, it contains your comment, doesn't it?

A Yes. There were a number of drill stem tests which gave no flow or very light flows. The ratio appears to be roughly about 3 dry to 1 gasser. The rate of flow on drill stem test appears to be proportional to the thickness of the Basal sand which varies from zero to 70 feet. This Lower Cretaceous gas is certainly pipeline gas since it could be produced in conjunction with the gas of the gas cap of the oil zone. It

is difficult to estimate the reserves because of the lack of essential data. However, assuming the available Lower Cretaceous gas is within the same area as the gas cap gas, that is, 10,700 acres and that one-third of this area or 3,500 acres will be productive, and that the average thickness is 20 feet with an effective porosity of 15%, then the void space is - $3500 \times 20 \times \frac{15}{100} = 10{,}500$ acre feet. The closed pressure is 1386 psia.

Gas per acre foot to 100 psia = $43560 \times \frac{1386}{14.4} \times \frac{520}{651} \times \frac{1}{.93}$

= 3.6 MMcf. per acre ft.

Gas Reserve - $10500 \times 3.6 = 38$ MMMcf.

Q Is that the same formula that you used earlier in this Report and that we were discussing?

A Yes, practically the same.

Q The 43,560 being the number of square feet?

A Yes, and the gas reserve for the 10500 acre feet would be 38 billion cubic feet.

Q DR. GOVIER: Mr. Slipper, where is the deduction for gas in place andabandonment pressure in that calculation?

A It has not been made.

Q It looks as though there was a slip there, doesn't it?

A Yes, right.

MR. NOLAN: It may look like it to Dr. Govier but I can not quite follow it. Is it in the mathematics or in the figures that are being used?

DR. GOVIER: I think just in the arithmetic. It looks as though Mr. Slipper may have forgotten to deduct that.

THE WITNESS: Instead of taking 1286 I took 1386 for my pressure.

Q MR. NOLAN: You should have done that or not?

A I should have done that, yes.

Q You should have taken 1286 instead of 1386?

A Yes.

Q And that would make a difference in your result?

A Yes. This is more than down to 100 pounds base pressure.

Q The thing for us to do, Mr. Slipper, is to make a new computation?

A Yes.

Q And show it in the Table.

MR. C.E. SMITH: Change 1386 to 1286, is that it?

MR. NOLAN: Yes.

MR. C.E. SMITH: Let him figure it.

MR. NOLAN: We will do it.

DR. GOVIER: It probably won't affect the overall.

MR. NOLAN: Not materially, no.

Q How would that 13 trillion be affected?

A THE WITNESS: A small amount. I do not know just how much.

Q Would it be about three or four billion?

A Something like that.

Q We will recap that figure.

MR. C.E. SMITH: Has anybody got a slide rule around here?

MR. NOLAN: Where is Mr. Hetherington?

Q Well now, this summary is built up on the same basis as the summary in the other tables 1 and 2?

A Yes, that is right.

S. E. Slipper - Dir. Ex.

TABLE III
SUMMARY OF LOWER CRETACEOUS GAS RESERVES

Name	Proven & Probable MMMcf.	Potential MMMcf.
Taber - 4 gas wells		No estimate.
Tilley & Bantry - 3 wells		
Princess - 11 wells	230 (Hume)	No estimate.
Jenner		
Hanna - 2 wells		No estimate.
Stettler Field & region, 5 wells,		Large reserves suggested - no definite estimate.
Vermilion	2	
Lloydminster	5	
North Edmonton region		1,000 MMMcf.
Pouce Coupe	100	
Redwater Oil Field		
Leduc Oil Field		38 MMMcf.
	337 MMMcf.	1,038 MMMcf.

See notation on Table II.

Q What is the difference between "no estimate" and "not taken into account"?

A That "no estimate", I believe there are gas reserves there but I can not estimate them. When I do not put anything in there I am not certain that there are reserves.

Q What about Jenner?

A Jenner I have not considered as a gas reserve.

Q Now, you have a note, "See notation on Table II", and that is for the definition of proven and probable and potential?

A Yes.

Q MR. NOLAN: Now, we come to a new classification, the Jurassic, which is also part of Group 4, and follows Lower Cretaceous?

A That is right.

Q As you go down, is that right?

A That is right.

Q I wonder if this would be a convenient place to break off because it does start on a new topic?

THE CHAIRMAN: All right.

(The Hearing then adjourned until 9:30 A.M., May 30th, 1950.)